Telephone Engineer

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Conveniences for the Lineman We sat in the office of a telephone manager during the late afternoon of one of the hottest days of the early summer. The sound of running water and the accompanying vocal performances prompted us to inquire if the telephone office had as a neighbor a YMCA building or a gymnasium. Without answering our question the manager signified that we should accompany him. He led us through a passage to an adjoining building which served as the company warehouse. In one corner under a shower bath were the three or four husky individuals that comprised the company's line gang disporting themselves.

Upon our inquiry as to whether the shower bath received much use, we learned that it was used at the close of each day during the warm season of the year. The manager went on to tell us that the men had installed the shower themselves, the company furnishing the material. The cost of a few feet of pipe, some fittings and the shower head was almost negligible and the work was done by one of the men who had some experience in pipe fitting. Even if the entire job had been installed by a local plumber the cost would not have been very large.

This led us to do some thinking about the possibilities of providing more for the men in the way of conveniences. Telephone companies have been very thoughtful in providing accommodations for operators and women employees. There is scarcely an exchange anywhere which does not have nicely furnished rest rooms for the operators and many of these are equipped with all kinds of conveniences. It does not require a large outlay to provide for the men not only shower baths, but some kind of club room facilities. Men are not particular about furniture and interior decorations. Many companies have enough unused furniture to equip such a club room and many have space available for it.

With a few simple furnishings and a small library made up of a few standard telephone books, catalogs and copies of TELEPHONE ENGINEER and other telephone publications, including manufacturers' and operating company house organs, such a club room will add something to the attractiveness of the job. From experience in a few places where it has been tried, the men will find ample time to make good use of it.

Keeping Up with Progress Is Necessary Reports from manufacturers of telephone equipment indicate that they are all doing a very satisfactory volume of business. In fact, schedules for delivery of new equipment have been lengthened in some cases on account of the amount of work in process. While this indicates a healthy condition in the telephone field it does not prove that all of the work is being done that is needed or that would be profitable financially to the operating companies.

One outstanding characteristic of American industry has been its willingness to scrap serviceable equipment whenever a new development makes it possible to reduce the cost of operation or production or to improve the quality of the service or product. Millions of dollars' worth of machinery and equipment have gone to the junk pile, not because they would not perform satisfactorily for many additional years but because some new design or process would permit production at a lower cost or in greater volume.

The telephone industry has not been lagging in new developments. New methods of operation, new circuits for switchboard and telephone apparatus, new designs of equipment are constantly being developed and the apparatus of ten years ago is already on its way toward obsolescence if it has not already reached there. This is one of the inevitable costs of progress. But the designers and engineers have constantly had in mind the effect of the new developments upon future quality of service, increases in capacity and costs of operation

so that the application of the new methods is almost immediately profitable.

Further progress is possible only if the operating companies take advantage of the developments as they are made. Every operating company owes it to its patrons, its stockholders and to the industry at large, to keep itself informed of progress in the art. It must not only keep itself informed but must apply the new developments in its own plant at the earliest practicable moment.

Some Encouraging Signs in the Small Exchange Field

At a recent district telephone meeting, a man told some of his experiences and ideas in rehabilitating small exchanges. This man is not an operator of telephone properties but is established in a business of his own. He will undertake to lay out and perform any construction or repair work desired by telephones companies, taking the job on a contract either for a flat amount or on a time and material basis.

The surprising thing about his talk was that he had completely or partially rebuilt over 300 small exchanges. These were principally for small stock or mutual companies where no one in the company organization was capable of doing the work. In the course of the talk it was brought out that many of these companies wished to do something to improve their plant conditions but were not equipped to do the work and did not have any means of getting into touch with some one who could go ahead with the job. In some cases a certain amount of work had been done each year for several years as the company could not afford to do all the necessary work in one year. In almost every case, means were found to do more work than was initially planned.

An occurrence showing the same trend was the visit of a president and secretary of a mutual company at a recent state convention. They drove over one hundred miles to visit the exhibit of a manufacturer from whom they had purchased a switchboard several years before. Repairs were needed and arrangements were made for a call from the manufacturer's representative. When the representative called a few days later and made a list of repair parts needed, the officers of the telephone company were willing to buy the material but hesitated because no one was available to put it into the switchboard. The salesman got into touch with a larger company in a nearby county seat and arranged for the loan of an equipment man for the job.

These instances are signs that there is a real desire on the part of many of the smaller units of the telephone business to keep in line with the industry as a whole by making improvements in their properties. What they lack in many cases is the knowledge of how to get the necessary work done. Many of these small units could not be operated at a profit by larger organizations, but most of them could be made to give passably good service as a connecting company to a larger unit. The opportunity for profit of the larger unit surrounded by a group of small units is often greater if it assists the small units to build up their properties than if it purchases and operates the properties.

The Accident Season

It is a matter of common knowledge that the summer season is the time of the greater number of accidents to telephone workers. Various reasons may be assigned for this. Among them are the increase in the number of less skilled men in the working force, fatigue incidental to hot weather, greater construction activity and many others. Whatever may be the cause which probably is a composite of all those suggested as well as some that have been overlooked, the fact remains and places a great burden upon those responsible for keeping the number of accidents to a minimum. For that reason the summer season should be the season of greatest activity in accident prevention work. This applies alike to the large and the smaller company. The larger companies usually adjust their accident prevention programs to take this into account. Among the smaller companies, this is not always the case. In fact, there are too many smaller companies still holding to the idea that no accident prevention work is necessary in their cases. We have said before that an accident record of two lost time accidents per year in a company employing ten men is just as bad as a record of two hundred lost-time accidents per year in an organization employing one thousand men.

The employer of ten men who had two lost-time accidents in a year, if they did not result in death or extended disability would consider that record to be a fairly good one while the employer of one thousand men with an accident record of two hundred lost-time accidents per year would spend thousands of dollars in investigating the causes and applying corrective measures.

The entire purpose of accident prevention work is to train the workman into the habit of thinking about the safe way of doing his job. In the larger company this requires elaborate machinery, but in the smaller company it is merely the projecting over to the men, the idea that the management expects every man not to take any unnecessary chances in doing his work and not to do work in a way that will be a source of danger to his fellow workmen and to the public. The close contact between management and men in the smaller companies should make this easy if management will do its part of the job.

Technical Discussion of Typical Program Service System

By FREDERIC C. YOUNG

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Introduction

The purpose of this article is to describe the functions of the parts of a typical installation bringing out the reasons for the use of these parts and the necessity for proper balance between them, so that the system may simulate as nearly as possible the ideal system. Special attention will be given to energy levels throughout the equipment.

Decibel

Inasmuch as it is convenient to use the term "decibel" (db) a brief description of the unit will now be given together with the reasons for the use of this unit.

When the energy in an electro-acoustical circuit is changed by one db, the effect is apparent to the ear as a small change in loudness of the reproduced sound. We define the decibel in terms of the ratio of the power before and after the change. For example:

Power ratio.	Decibels.
2	3
5	7
10	10
100	20

If, in a system we start with a small amount of power and desire to find the power at any point in the system which contains amplifiers, lines and artificial networks, it is necessary to multiply the initial power by the output power and input power ratio of the various devices up to the desired point. This is cumbersome and no idea is had of the effect upon the human ear. In contrast with this the desired information can be expressed in db. The various gains and losses can then be added instead of using the inconvenient multiplication method. In addition, the effect can be interrupted in terms of the change in loudness perceptible to the human ear. The change from multiplication to addition is made possible by the logarithmic relation which exists between the decibel and the corresponding power ratio + refers to levels above zero level and — refers to levels below zero level.

Zero Level

So far, we have used the db to show the difference between the two powers under consideration, or, in other words, the final value of power referred to the initial value of power. The initial value of power varies with the conditions under consideration and, in order that we may compare the power levels in different cases, it is convenient to refer all levels to an arbitrarily selected base. This base or "zero level" has been taken as 0.010 watt, which is the electrical power output of a common battery substation on zero loop. Levels in this paper are referred to zero level as here defined. Zero level is defined in terms of the electrical part of the circuit and levels referred to it in this paper pertain to levels in the electrical circuit only. For example: If further on a level of + 15 db is mentioned in connection with a loud speaker, it will mean that electrical power is furnished to the speaker at a + 15 db level and will not refer to the level of the sound output from the speaker.

At the sending end of a temporary pick-up point, power from the microphones, which is at a level of — 50 db, is raised by an amplifier to, say, + 5 db. (It is necessary to amplify the signal before putting it on the line to override line noise.) A volume indicator (VI) is bridged across the output of the amplifier, so that the operator may have a visual indication of the level being put on the line. An artificial line, having a loss of 10 db, is inserted in the circuit beyond the volume indicator to eliminate the effect of cable capacitance on the operation of the volume indicator. The output of the network is connected to the line running to the control room

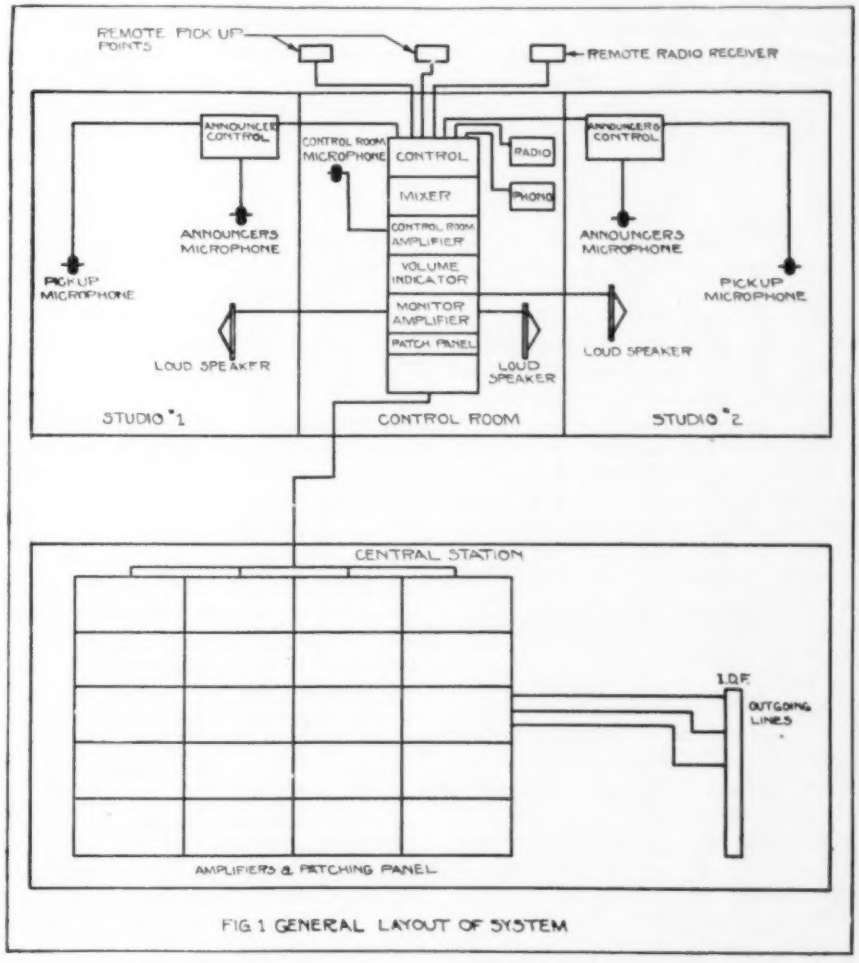

FIG 1 GENERAL LAYOUT OF SYSTEM

Field Pick-Up

In explaining the action of the system, recourse will be had to the line diagram shown as Figure 1. All references hereafter are to this figure unless otherwise specified.

where a variable network drops the level to about — 50 db, which is the correct level for entering the control room amplifier.

Control Panel

The various pick-up, studio, radio and phonograph programs are terminated on the control panel and by means of keys and relays any program or combination of programs may be thrown on the amplifier busses. Lamps, associated with the keys and relays show what program is in progress. The control panels are in multiple in the studios and control room and the circuits may be arranged, so that only one program may be on at a time or vice versa.

Mixer

The mixer consists of separate input channels with individual microphone battery supply and volume control. These circuits are common on the output side of the circuit. By means of the mixer, parts of a program may be correctly proportioned in volume. For example: Announcing with a background of music or having two or three points of pick-up for a large orchestra. The mixer works into the control room amplifier.

Control Room Amplifier

The maximum gain of the amplifier is 70 db and may be varied over a sufficiently wide range to get the flexibility desired to meet all necessary conditions. As described under "Field Pick-up," a volume indicator and network are inserted beyond the control room amplifier. If more than one central station is to be fed, a separate line amplifier for each is furnished. In any event, the signal goes on the line at from 0 to + 2 db. The signal from the line operates the central station amplifier.

Monitoring

A monitoring amplifier and loud speaker are provided, so that the program as it leaves the control room amplifier and as it comes back from the central station amplifier may be heard and compared.

Lines

The lines interconnecting the various parts of the system should be in good condition and furnished in duplicate, so that in case of trouble the equipment may be switched from line to line. It is advisable, in order that lines may be well balanced to ground and thus keep down noise, to terminate the lines with well-balanced repeating coils.

Due to cable capacitance, lines have frequency characteristics which should be flattened in order to give more perfect reproduction. By shunting a line equalizer across line terminations and properly adjusting this equalizer by means of an oscillator at the sending end and a volume indicator at the receiving end the line characteristics variation may be practically eliminated.

The equipment, which works into and from lines, should be matched to the line and deliver power at a level which is high enough to override line noise and low enough to prevent cross talk into the telephone circuits which are in the cable with the program service lines.

Considerable misunderstanding seems to exist among practitioners concerning the expression "matched impedances." It can be proved that a generator having a given internal impedance will deliver maximum power to a load whose impedance equals that of the generator. Unfortunately we cannot control the two impedances under all conditions and, therefore, we have recourse to transformers. A transformer is an impedance changer, so to speak, and its ratio of impedance transformation should equal the ratio of the generator impedance to that of the load. For example: To connect a 1,000-ohm generator to a 5,000 ohm load, a transformer having a ratio of $\frac{1000}{5000}$ should be used. As seen from the generator terminals and looking into the transformer, the load will not appear as 5000 ohms, but as $5000 \times \frac{1000}{5000}$ or 1,000 ohms. Now, from the same terminals, if we look toward the generator, the impedance seen is 1,000 ohms. This means that, at the point at which we broke into the circuit, the impedance, as seen looking in one direction, is equal to the impedance as seen looking in the other direction. In other words, the impedances are matched at this point.

It is sometimes stated by people, who should know better, that the output impedance of a vacuum tube should be matched to the primary of the output transformer. In a perfect transformer, the windings lose their identity as such when considering the impedance looking into one winding of the transformer when the other winding is connected to a load. The value of the primary impedance of a transformer for a given service varies with the particular constants of the iron structure and its value is merely a matter of designs and is juggled with the idea of obtaining a good frequency characteristic and low loss.

Power Supply

Grid and plate voltages for the tubes are readily furnished through rectifiers from A-C power lines. So far, in high-gain high-quality systems such as the one described, best results have been obtained by using battery to supply the microphones and filaments of the control room amplifier. The power amplifiers are completely A-C operated.

Duplicate Equipment

In systems, where high reliability is essential, all equipment is in duplicate including standby batteries for all the equipment and a hand-wound spring phonograph motor.

Power Amplifiers

Power amplifiers are defined as the amplifiers which deliver signal power to the speaker load. Early in program service work when only low-load capacity tubes were generally available, a multiplicity of small battery-operated amplifiers was used. At present, high-load capacity A-C-operated amplifiers are coming into general use. These amplifiers are of the push-pull type, using four UX-250 tubes, giving an undistorted output of approximately 22 watts. The push-pull circuit is used to make the amplifier overload point independent of the output load impedance to reduce hum and to increase the load capacity of the amplifier over that of the same number of tubes used in any other circuit. The output transformer is so tapped that headset, moving iron and dynamic speaker channels are provided or so that various-sized groups of moving iron speakers are matched to the output impedance of the amplifier.

When a large number of speakers is used, a number of the power amplifiers may be connected in parallel on the input side and separately connected to their various loads on the output sides.

Patching Panel

An original low-capacity amplifier had its output circuit divided into two parts feeding to line groups of five lines with two speakers per line. Thus, in case of line trouble, only a small block of speakers was affected. With the large power amplifiers practically the same segregation may be had by the use of a patching or distributing panel, shown in Fig. 2. Each amplifier is connected to a strip of ten jacks. Jack No. 1 is used for monitoring. Jack No. 2 is used for cutting the line from the jacks and, by a patching cord, it may be connected to Jack No. 1 of any other strip. Each jack, from No. 4 to No. 10 inclusive, has its main blades connected to a group of paralleled lines. If trouble be suspected on a line group, it may be plugged out with one end of a patching cord, the other end of which may be plugged in a test jack at the bottom of the same panel. These test jacks may be connected to the wire chief's desk for test purposes.

These jack strips are all mounted on the same panel and one jack per spare amplifier is provided, so that, by means of a patching cord, any spare amplifier can be quickly connected in place of any amplifier by plugging one end of the cord in the spare amplifier jack and the other end in Jack No. 2. Various other cross connections can be made.

Having all the output circuits of the amplifiers available on our panel, an extremely flexible arrangement is provided. Various modifications of this patching panel are possible.

Speaker Levels and Amplifier Capacity

The level, at which a speaker operates depends upon the size of the room to be served, the acoustical constants of the

room, and the part the entertainment is to play in the scheme of things. As a result of experience, it is found that the following levels are satisfactory:

Hotel guest rooms..+7.0 db (0.05 watt)
Living room.....+11.5 db. (0.14 watt)
Hotel lobbies.....+14.5 db (0.30 watt)
Large auditorium .....(20 watts)

A typical example of the method of calculating amplifier capacity will be illustrated, as follows:

Assume:
1,000 guest rooms
200 living rooms
3 lobbies
2 very large auditoriums

Capacity per amplifier = 22 watts

Calculate:

Power for guest rooms = 1,000 rooms x 0.05 watt =..... 50 watts
Power for living rooms = 200 rooms x 0.14 watt =..... 28 watts
Power for lobbies = 3 rooms x 0.030 watt =..... 0.9 watt
Power for auditoriums = 2 rooms x 20 watts =..... 40 watts

118.9 watts

$$\text{No. of power amplifiers} = \frac{118.9}{22} = 6$$

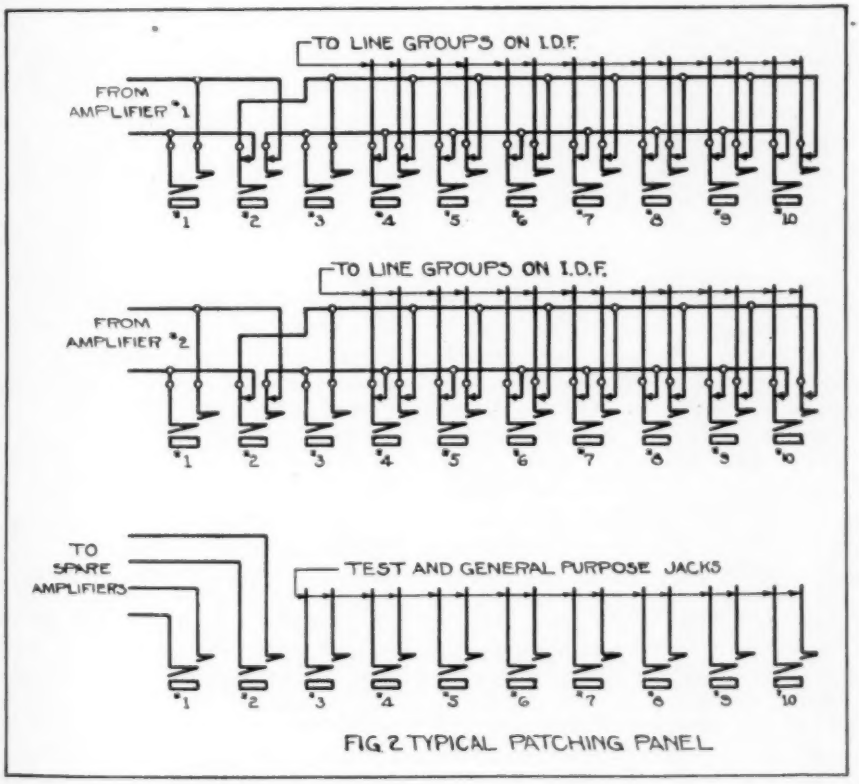
TO LINE GROUPS ON I.D.F.
FROM AMPLIFIER #1
#1 #2 #3 #4 #5 #6 #7 #8 #9 #10
TO LINE GROUPS ON I.D.F.
FROM AMPLIFIER #2
#1 #2 #3 #4 #5 #6 #7 #8 #9 #10
TO SPARE AMPLIFIERS
TEST AND GENERAL PURPOSE JACKS
#1 #2 #3 #4 #5 #6 #7 #8 #9 #10

FIG. 2 TYPICAL PATCHING PANEL

Another misconception seems to be that, adding more speakers to an amplifier, increases the output from the system. This is not the case, since just as much power can be delivered to one speaker as to a total of 100. Adding speakers to an amplifier does not overload it a bit, provided matching conditions are kept constant. Overload in an amplifier is dependent upon the voltage applied to the grid of the amplifier. An amplifier differs from a generator; in that, the amplifier impedance is comparable with the impedance of the load and that it is designed to deliver the maximum power it is possible to draw from the amplifier. A generator or alternator has an impedance which is low compared to its load and is not designed to deliver the maximum power it is possible to draw from the generator. The generator load is increased by putting more and more motors across it, since initially we have a load impedance high compared to the generator and, upon increasing the load, we come nearer to matching the impedances which means that more power is drawn. However, we cannot go further with the load without overloading the generator.

Cable Circuits

In program service installations in cities where cable pairs in the same cable with telephone circuits are used, cross talk must be taken into consideration. As a result of experience, it appears that cross talk encountered is due to electrostatic coupling. Therefore, the voltage impressed on the cable pair must be low enough (say 10 or 15 volts), so that cross talk will not be experienced. Consequently, when it is desired to supply power at a high level, a local amplifier is necessary at the place of reproduction.

The characteristic, introduced by the cable, gives a very undesirable condition which must be compensated for by proper proportioning of the loud speaker and amplifier characteristics.

Open-Wire Lines

These lines are practically free from the cross talk limitation and, in addition, have a very good frequency characteristic when inserted between the amplifier and speakers which are correctly matched to the line by transformers.

Otto Marahrens Made General Manager of Fort Wayne Company

Appointment of Otto Marahrens as general manager of The Home Telephone and Telegraph Company of Fort Wayne, Ind., was announced by Frank E. Bohn, president, following a meeting of the board of directors, Tuesday, June 18th.

Mr. Marahrens, who is secretary of the company, had been acting as assistant general manager for some time. He succeeds Mr. Bohn as general manager, and will continue his duties as secretary. The appointment became effective immediately.

Mr. Bohn will continue as chief executive of the company, and will devote all of his time to the office of president. The new appointment became necessary to handle the increase in the company holdings due to the acquisition of additional properties in its territory and the growth of Fort Wayne, officials said.

Started in 1903

Mr. Marahrens has been in the employ of The Home Telephone and Telegraph Company for 26 years, starting as a messenger in 1903. Since then he held the position of bookkeeper, accountant, auditor, assistant secretary, secretary, and assistant general manager. During his service with the firm the number of subscribers was multiplied more than 30 times, growing from 2,451 to 33,142, and the system advanced from the magneto telephone to the present automatic system, admittedly one of the finest in the world.

Fort Wayne Pennsy Gets P. A. X.

A 200-line Private Automatic Exchange recently was cut into service at the Fort Wayne offices of the Pennsylvania Railroad Company.

Installation was made by The Home Telephone and Telegraph Company of Fort Wayne. Work on the system was started on May 15th, and was completed on June 3rd, when the cutover took place.

This Private Automatic Exchange is the third system of its kind in Fort Wayne. The Fort Wayne branch of the General Electric Company and the Indiana Service Corporation both have used similar systems for some time.

Studying Telephone Methods

{ This Is Chapter 29 of a Series of Articles by E. R. Collins, Manitoba Telephone System, Brandon, Manitoba, Canada. Relays Are Further Discussed in This Article }

The telephone operator receives the request of the subscriber to call a certain telephone. She then proceeds to transform the spoken request into muscular movements necessary to make the desired connection. We can imitate these steps by mechanical means. The subscriber first of all changes his mental wishes into muscular movements, necessary to remove the receiver from the hook, and turn the wheel of the calling device or dial. This in turn transmits impulses over the line, to operate relays. The relays in turn must control some mechanical device to take the place of the movements of the operator in making the connections with the cords and plugs. We will study in this chapter some of the requirements of the mechanical devices to do this work.

Ratchet Wheel and Lever.

In Fig. 239 is shown a sketch of a ratchet wheel with a lever and two pieces of metal commonly called "dogs." This looks so simple that it would seem foolish to spend much time talking about it. But such devices can be very obstinate if one does not fully understand their peculiarities. The ratchet wheel is mounted on a shaft, and the shaft bearings are part of the same foundation plate that mounts the lever and the piece marked "dog." The pawl mounted on the lever is shown resting behind tooth No. 1. If the lever is pressed to the left it naturally forces the ratchet wheel around with it. The dog is shown resting behind the lip of

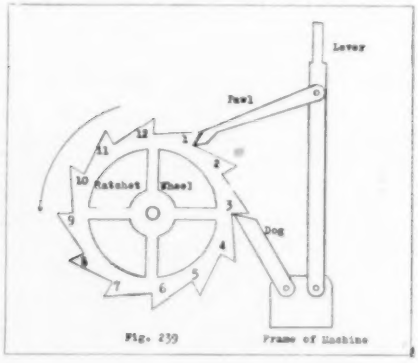

Fig. 239

No. 3 tooth. The lever may be moved to the left so that two or more teeth will pass by the "dog." If the movement of the lever is very quick, the ratchet wheel may be made to spin around quickly. In order that we may change the movement of the lever into a rotary motion of the ratchet wheel, two things are necessary. The shaft of the ratchet wheel must be mounted so that the center of the wheel cannot move away from the pressure of the pawl on its rim.

The lever must have its pivot point at the lower end so fixed that the position

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Department of State Railways
Telegraphs, Telephones and Signal Branch
Bangkok (Siam)
May 9, 1929.

The TELEPHONE ENGINEER,
192 North Clark Street,
Chicago, Ill.

As a reader of the TELEPHONE ENGINEER, I am glad to inform you that I am very much interested in the "Studying Telephone Methods," by E. R. Collins. It is very unfortunate that I am unable to obtain complete articles by this gentleman. Will you be kind enough to inform me if these articles will ever be published in book form, or how could all the former installments be obtained?

Thanking you for a reply, I am

Yours faithfully,
S. PALASIRI,
Assistant Electrical Engineer.

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of the lower end of the lever will be constant and all the pressure imparted at the upper end will simply cause the upper end of the lever to move. With these two points held at a fixed distance from each other, we can cause the wheel to rotate, when a straight pressure is applied to the lever toward the left.

It follows then that any slackness at these two pivot points will cause a loss of motion on the rim of the wheel. Therefore there should be a minimum of play at the wheel shaft bearings, and also in the pivot points of the lever and the pawl.

Stroke of Lever

In order that the ratchet wheel device may be of any use to us we must confine the movements of the wheel within certain limits. We might have the wheel turn two tests at a time, or three at a time. We will, however, base our study on moving the wheel one tooth at a time. This is commonly called a *Step by Step movement.* In Fig. 240 we have changed the arrangement. A drum is attached to the ratchet and the shaft. On this drum is wound a cable to which is attached a weight. This weight will have a tendency to cause the wheel to turn to the right. In Fig. 240 the pawl is resting behind tooth (1) while the dog is resting behind tooth (3). We will assume that the weight is all resting against the dog. With the pressure being held by the dog, it should be possible

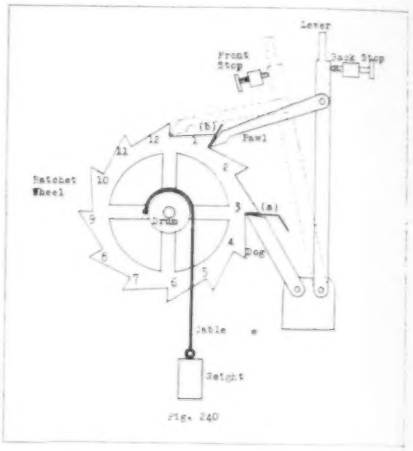

Fig. 240

to lift out the pawl and the wheel will not turn to the right. Suppose that the lever and pawl are in the position shown by the dotted lines. Then pull the lever to the right until the pawl drops in behind tooth (1). In this case the pawl must depend on its weight to force it in behind "tooth one." If the lever is not moved to the left far enough to prevent any friction between the face of tooth No. 1 and the pawl, the pawl will not drop all the way down, if at all. We must therefore move the pawl to the right far enough to allow this free movement.

We have shown two adjusting screws, marked front stop and back stop. They are mounted in metal lugs mounted on the common frame work which supports the shaft, the dog and the lever pivots. We can adjust the back stop therefore so that the lever can be pulled a limited distance to the right. At (b) is shown a heavy black line. This represents a thickness gauge of say 2/1000 of an inch or .002". Slip this gauge between the tip of the pawl and the face of the ratchet tooth No. 1. Then adjust the back stop until there is a pressure placed on the thickness gauge. Next turn the screw back slightly until the gauge can be lifted out easily, and lock

the back stop adjusting screw. This will leave a clearance of .002" between the pawl and the face of the tooth of the ratchet wheel. If all the teeth are of a uniform length, and the shaft of the wheel true, then there should be a uniform clearance of .002" between the pawl and each tooth. If the lip of a tooth should be burred by a piece of hard metal there might be enough hang over of the lip to prevent the clearance of one tooth. A fish back file No. 2 or No. 3 is the proper tool to clean up the face of a burred ratchet tooth. The fish back file has only one cutting face and the fine grade can be used with care to clean the faces of ratchet wheel devices. The front stop is to prevent the stroke of the lever from moving the ratchet more than the length of one tooth. This can be adjusted by using the thickness gauge at (a) instead of (b). Allow the pawl to take the pressure of the weight, and adjust the front stop so that the lever will carry the wheel slightly farther than one tooth. Slip the thickness gauge between the tip of the dog and the face of the tooth, as shown in Fig. 240 at tooth No. 3. Adjust the front stop until the pressure is just felt on the thickness gauge, and lock the screw. You have now provided a uniform clearance between the dog and any tooth of the wheel provided the teeth are of a uniform length, and free of all burred edges. It should be quite evident that if there were excessive play in the shaft bearings, or the pivot points of the lever or dog, or the pawl pivots, that this adjustment might be too close to allow the pawl or the dog to drop in easily. All such excessive play should be avoided. Now if the lever is operated its full stroke, that is to come firmly against the front stop, the ratchet wheel can be moved the length of one tooth. The dog will hold the pressure of the weight while the pawl is coming back for the next tooth. Thus we may turn the wheel over to the left until the weight is wound up its full height.

Preventing Overthrow

If the lever is driven to the left quickly enough, for example in figure 239, where there is no load attached, the momentum of the wheel would carry it around at least several teeth, of course depending on the speed of the stroke. This is termed overthrowing where a step at a time only is intended. Yet in actual operation the lever is driven at a tremendous speed, and the wheel must be driven at the same speed, and brought to a stop between each stroke of the lever.

In figure 241 we have the same arrangement as in figure 240, except the shape of the pawl, and the position of the front stop. Here the pawl is curved abruptly at the tip and is cut away under to allow clearance over the ascending tooth under it. Now suppose the lever is in the position as shown in the dotted lines, the pawl would be resting behind tooth No. 2. Then if the lever is brought to the left it would drive tooth No. 2 over into the position of No. 1 tooth. Just as the dog has dropped in with its clearance of .002" the pawl hits the front stop. The position of the set screw of the front stop causes a pressure down as well as back against the lever, so that while the lever is stopped from coming any further to the left, the pawl is pressing down on the bottom of the tooth of the ratchet wheel. This being the lowest point in the tooth, it prevents the rising portion

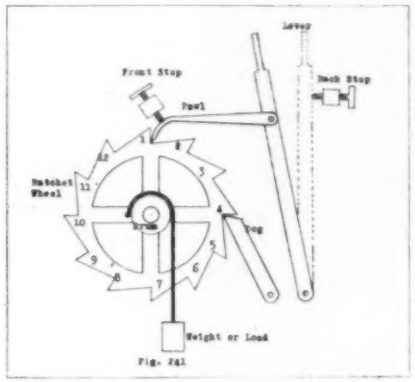

Fig. 241

of the next tooth from advancing any further, and locks the wheel in this position as long as the pressure is maintained on the lever. Now if the lever is moved only a part of the stroke, the pawl will not come in contact with the front stop, therefore if the partial stroke of the lever is fast enough the wheel may be driven more than one tooth. The locking of the wheel at each stroke therefore depends on the stroke being made its full length. A part length stroke may be caused by a lack of energy to drive it the full distance, or a weak stroke, and yet it may have sufficient speed at the start of the stroke to drive the wheel more than the one step.

If you will refer to Fig. 242 the position of the front stop is shown differently. In this case the pawl tip is held away from the teeth by the pawl spring. As soon as the lever commences to move, the front stop pressing down on the tip of the pawl causes it to come behind a tooth of the ratchet wheel, before the wheel commences to move. If the lever is held in this position, that is just pressing behind the tip of a tooth, and then the wheel turned to the left by the other hand, the next tooth coming up will hit against the lower side of the pawl, and be brought to a stop. In this case the locking feature is brought into effect almost as soon as the lever commences to move and as soon as the pawl presses against a tooth face.

Electric Drive

In Fig. 242 instead of the hand lever we have an electro magnet arranged to operate the lever. The lever is made the extension of the armature, of a similar construction to the relays discussed in the previous chapter. The magnet is wound with a coarse wire, so that a heavy current may be passed through. This will cause a maximum pull of the coil on the armature. The armature and the lever will be found to be of heavy construction to give sufficient rigidity to the structure.

The dog is held into the teeth with a spring pressure. The pawl is held out of the teeth with spring pressure of the pawl spring. The dog and the pin to hold the dog spring are mounted on the common framework with the shaft of the wheel, and the frame of the electro magnet and its armature. The front stop is supplied with an adjusting screw, so that its position on the frame work may be altered to give the proper adjustment to the pawl. The back stop is also adjustable as shown in Figs. 240 and 241.

When current is applied to a relay the pull of the armature is instantaneous. The distance the armature has to travel toward the core is so slight that the speed is not noticeable. When a lever is built on the armature as in Fig. 242 the matter of speed can be seen easily. A given example of an armature has a ratio of 3—1. That is the distance from the armature pivot to the pawl pivot is three times as great as the distance from the armature pivot to the center of the core. Therefore the pawl will travel three times as fast as the armature toward the core. This gives a tremendous speed to the travel of the pawl, giving a hammer-like blow to the teeth of the ratchet wheel. Therefore if the key in Fig. 242 is pressed the armature will drive the pawl into the ratchet wheel with great force. Again the pressure required to remove the ratchet wheel one tooth can be measured two places. A gauge may be attached to the armature lever at its upper end, so that the gauge will move the armature lever instead of the magnet. The pressure required with a certain armature was 800 grams. Now if the armature lever ratio is 3 to 1, then 2400 grams will be required to do the same work if applied upward against the armature at a point at the center of the core of the coil. This means that the magnetic pull must be almost 5 pounds to drive the load of the armature. The load consists of the weight attached to the ratchet wheel, plus the friction of the moving parts, plus the pull of the armature spring. The armature spring is necessary to pull the armature back to its normal non-operated position quickly when the

current is cut off. The end of the core next to the armature is covered with a thin coating of brass or copper to prevent the armature from sticking to the core, due to residual magnetism.

The operation of the device shown in Fig. 242 will have a tendency to excessive wear on the parts. This will be due to the speed and power of the blows of the lever and the pawl when the current is applied, where the magnetic drive method is used. Another method is not so severe as shown in Fig. 243.

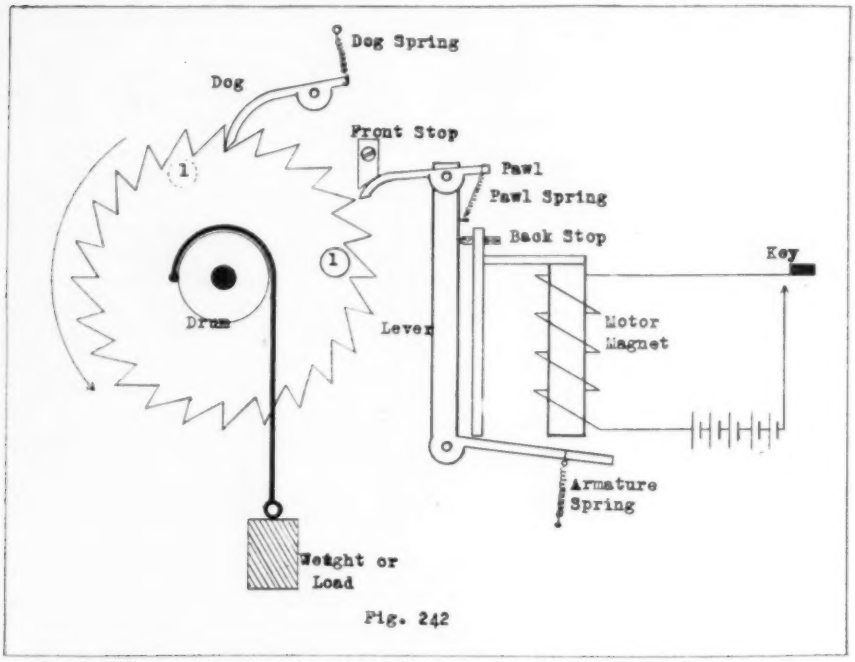

Fig. 242

In Fig. 243 the dog is held into the teeth with a spring pressure, and also the pawl is held into the teeth with spring pressure. In the normal non-operated position therefore both the dog and the pawl are resting each behind a tooth of the wheel. When the current is passed through the coil the armature will pull the lever to the right, and move the pawl away from its position. The spring pressure of the pawl will cause it to follow along the shape of the tooth until it drops over the next lower tooth. The armature in this case must overcome the armature spring tension to complete its stroke. When the current is cut off again the spring pressure of the armature spring forces the lever to the left again. But the pawl having dropped behind the next tooth, carries the wheel along with it, until the pawl hits the front stop, and locks the wheel again. Now the big difference between the two methods is due to the following: When the armature is moving towards the core the pull increases as it draws closer to the core. Thus the speed will increase as it draws closer to the core. Therefore at the finish of the stroke in Fig. 242 the armature is traveling at its maximum speed. There as the pawl hits the front stop in Fig. 242 it is traveling at its highest speed, and delivers the heaviest blow to the wheel and the front stop. In Fig. 243 the armature is driven to the front stop and wheel by the spring pressure. The pull of the spring will be greatest when pulled out the greatest distance. Therefore at the commencement of the travel toward the wheel and the front stop the speed will be greatest, diminishing as it approaches the stop. Therefore when the pawl wedges between the front stop and the wheel the armature is traveling at its minimum speed, and the weight of the blow is diminished. This then would be the method likely to cause the smallest wear on the segment wheel, and the pawl and armature.

Release Action

We have discussed so far only the method of driving the wheel to the right. Suppose as in Fig. 240 we drive the wheel forward 5 steps. This winds up the weight and places a pressure on the pawl and the dog. Now if we want the wheel to return to the normal position we must lift out both the pawl and the dog to clear the teeth of the ratchet wheel. We can move the lever forward a little to relieve the pressure against the dog, and lift out the dog. Then the pawl will have to be lifted out against the pressure of the weight to allow the wheel to return.

In Fig. 241 if the lever is brought into the position of the dotted lines, the pawl might be turned back, and leave the pressure on the dog. Then the dog might be lifted out against the pressure of the weight attached to the cable. This requires power to lift out the dog against this pressure.

In Fig. 242 the normal position of the pawl is clear of the teeth, so that only the dog must be moved to allow the wheel to return to normal. Suppose then in Fig. 242 the wheel has been driven around till tooth (1) takes the position as shown by the dotted circle. Then to allow the wheel to return to normal position as shown by (1) in the solid circle, we must lift out the dog. This can be done by equipping the dog with a magnet and wiring into a proper circuit. Such a method will be discussed later.

In Fig. 243 we have omitted the weight. The wheel may be equipped with wiper springs, which together with the natural friction of moving parts will form a load against motion. Yet they will not cause the wheel to turn if the dog and pawl are both withdrawn. Therefore if the wheel is turned until tooth (1) comes into the position shown by the dotted circle, and the dog and pawl both held blear of the teeth, there is nothing to return the wheel to its normal position. However, since there is no limiting cable and weight attached, we can turn the wheel to the left as far as we like. If enough additional impulses are applied we can drive the wheel around until (1) comes back to its normal position again after traveling once

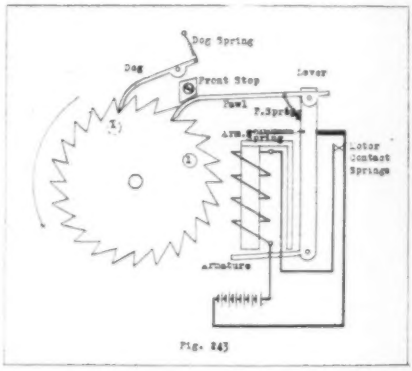

Fig. 243

around the circle as shown by the arrow. However, it is not necessary to apply additional impulses to complete this additional travel. The electro magnet may be equipped with springs as shown in Fig. 243. Here a pair of contact springs are connected in series with the motor magnet. The spring No. 2 is driven to the right when the armature is pulled up. Spring No. 1 is so tensioned that it will hollow spring No. 2, until the pawl drops over the lip of the next tooth. Then the magnet lets go and the armature spring pulls the lever to the left again and moves the wheel on one step. The contact, however, makes again and pulls the armature to the right again. Thus a buzzer action is set up which will drive the wheel around rapidly.

Suppose that the wheel had been driven step by step until the tooth No. 1 stands in the position shown by the

(*Continued on page* 44.)

Practical Suggestions for Plant Valuation

By CHARLES W. McKAY, M. E.*

Again, it may happen that the valuation of a telephone properly discloses the fact that the plant is more elaborate than the operating conditions warrant. For instance, if the 1,000-station plant we have been considering showed a reproduction cost of $100 per station for the physical property alone, and further analysis proved that the company was possessed of an excessive amount of costly underground conduit construction, it would obviously be unfair to force the subscribers to pay rates based upon the $100 per station valuation. In other words, the appraisal engineer must not only assure himself that the valuation of the property is a fair one, but he must also determine whether or not the plant is suitable to fulfill the requirements of the case in hand.

If the plant is inadequate, either due allowance should be made for this fact in determining the rates, or the rate investigation should be postponed until the company has installed all of the plant and equipment necessary to furnish good service to its subscribers, and until it is in a position to submit a fair valuation of the reconstructed property. If the plant is overbuilt it may be necessary to shade the reproduction cost valuation a little so that the subscribers will not be forced to pay for a lack of engineering foresight in planning the property.

Operating Expenses.—The operating expenses of a telephone company may be divided into four general headings, maintenance expenses, traffic expenses, commercial expenses, and general or miscellaneous expenses.

The maintenance expenses include such items as repairs, salaries, office and traveling expenses of superintendents and their assistants who are directly in charge of the maintenance of the telephone plant.

Traffic expenses include salaries, traveling and office expenses of the forces engaged in the supervision of traffic; salaries of telephone operators; cost of miscellaneous office supplies; cost of rest and lunch rooms; cost of operators' schooling; cost of central office stationery and printing, etc.

Commercial expenses include the cost of advertising, canvassing, accounting, collections, etc.

The general expenses include the salaries of general officers, the salaries of general office clerks, expenses incurred for stationery, supplies, cost of legal advice, insurance, amounts paid for accidents and damages, and all of the other miscellaneous expenses which cannot be classified under the headings, "Maintenance," "Traffic" and "Commercial."

Ordinarily, depreciation would be considered as a part of the maintenance expenses. However, for the purpose of the illustration, the item of depreciation is being considered separately. In fact, many public utilities, other than telephone companies, consider depreciation as a deduction from net operating revenue rather than as a part of the operating expenses.

Annual Depreciation.—It is hardly necessary to dwell at length upon the subject of annual depreciation. This subject has been discussed in considerable detail in the foregoing chapter. It might be stated that in determining the amount of annual depreciation it is first necessary to ascertain the reproduction cost of the physical property and the respective lives and salvage values of the component elements. An annual depreciation fund is then built up which will meet the requirements of the case under consideration.

Revenue.—Revenue of a telephone company may be divided into three general classifications—exchange service revenue, toll service revenue, and miscellaneous operating revenue.

The exchange service revenue, as the term suggests, includes the revenues derived directly from the sale of exchange service.

The meaning of the term "toll service revenue" is also apparent. Any telephone company of appreciable size has some provision for toll service. It may not own its own toll lines, but it at least will have an operating agreement with some larger company whereby its subscribers may receive the benefit of toll service.

If the company owns the toll lines, naturally all of the revenue derived from toll service will be included in the item "Toll Service Revenue." If the company does not own the toll lines, it probably will have a working agreement with a toll transmission company whereby it will receive a certain percentage of the gross revenue resulting from toll service. In a case of this kind the percentage thus received will be chargeable to toll service revenue.

Miscellaneous operating revenue includes such items as rentals for private or leased lines, messenger service, telegraph commissions, revenues derived from advertising in the directory, rentals from subleased property, etc.

Rate of Return.—The rate of return which a telephone company may expect to derive from its investment is largely dependent upon the attitude of the utility commission under whose jurisdiction the company operates. In many states 8 per cent is considered a fair rate of return.

This question of the return which should be allowed to investors in public utility properties is a delicate one. It is certain, however, that no sane investor will consider buying the stock of a utility corporation unless he can be assured that he will obtain a larger return than he could if his funds were invested in mortgages or bonds. It is a well-known fact that first mortgages on farms, and sometimes on city property, can be obtained which will net a return of 6 per cent. All things considered, 8 per cent may be assumed to be a fair return on an investment in telephone stock, and this percentage will be used in the illustrations cited in the present chapter.

First Step in Illustrative Rate Investigation.—With the aid of the foregoing general discussion of the various factors that enter into a rate problem, and with the help of the simple illustration given previously, the reader will be able to readily follow the analysis of a more complicated rate problem.

It will be assumed that a company

New England Telephone and Telegraph Company

Boston, Mass.,
June 13, 1929.

Charles W. McKay, M. E.,
Consulting Telephone Engineer,
192 North Clark Street,
Chicago, Ill.

Dear Sir:

I have been interested in your articles in the TELEPHONE ENGINEER on "Practical Suggestions for Plant Valuation." Are these articles published in book form, and, if so, what is the charge for the book?

Yours truly,
H. S. PALMER,
Engineer of Toll and Tandem Studios.

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*Charles W. McKay, M. E., 192 N. Clark St., Chicago, Ill.

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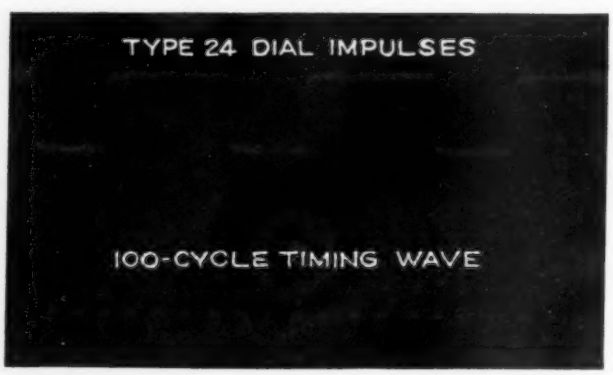

The oscillogram shown here indicates clearly the definite, clean-cut character of the impulses sent out by the Type 24 Dial. It will be seen that there is no "chattering" at any point on the curve.

STROWGER

Product of Many Minds—
The Type 24 Dial

THE Type 24 Dial is a product of the Research and Development Staff of Automatic Electric Inc., which numbers among its members some of the most outstanding technical experts in the telephone field. This dial embodies in its construction all of the principles of previous designs which forty years of experience in manufacturing dial telephone equipment have proven to be fundamentally sound.

The Type 24 Dial is practically noiseless in operation, due to its exclusive worm gear and ratchet design. The impulses it generates are sharp and clear-cut, being entirely devoid of chattering either on the "make" or on the "break." There is no possibility of "overthrow," no matter how quickly or carelessly the dial is operated. If the finger plate is accidentally bent, it does not take a permanent "set," but springs back into perfect alignment. These advantages, coupled with unparalleled reliability and endurance, are some of the reasons for the adoption of this dial by telephone administrations in twenty-four different countries of the world.

Automatic Electric Inc.

Manufacturers of

STROWGER AUTOMATIC DIAL TELEPHONE AND SIGNALING SYSTEMS

Factory and General Offices: 1033 West Van Buren Street, Chicago, U. S. A.

Sales and Service Offices in All Principal Cities

EXPORT DISTRIBUTORS

For Australasia . Automatic Telephones, Ltd., Sydney
For Canada . Independent Sales and Engineering Co., Ltd., Vancouver
Elsewhere . The Automatic Electric Co., Ltd., Chicago

ASSOCIATED COMPANIES

American Electric Company, Inc. . . . . Chicago
International Automatic Telephone Co., Ltd., London
Automatic Telephone Manufacturing Co., Ltd., Liverpool
The New Antwerp Telephone & Electrical Works, Antwerp

GERIAL SYSTEMS

located in a town of about 10,000 population is giving exchange service to about 3,000 subscribers, and that it has applied to the sate publicity utility commission for permission to increase its rates. To simplify the illustration, it will be assumed that the rates for exchange service are the only ones involved in the investigation, and that toll service is supplied by a separate toll company. In a case of this kind the only revenue derived from toll service by the exchange company would be in the form of a percentage on the total receipts from toll calls originating in the company's territory.

Naturally, the first step in a rate investigation of the kind under consideration will involve a complete valuation of the company's physical property and of the attached business. For the purpose of this discussion it is unnecessary to outline the various steps involved in the appraisal, this phase of the subject having been discussed quite thoroughly in previous chapters. It will be assumed that a careful engineering valuation has been made of both the physical property and of the so-called "intangible assets."

The Inventoriable Property.—The result of the appraisal of the physical property is shown in Fig. 52. It will be noted that the accounting system of the Interstate Commerce Commission has been followed in determining the general agreement of what may be called the "inventoriable property." Under the heading "Distribution System," are grouped all of the elements of outside plant, such as poles, cross arms, aerial cable, underground cable, conduit, etc.

It will also be noted that suitable allowances have been included to cover the cost of contingencies, warehouse and purchasing expense, tool expense and the collateral construction costs. If the reader is in doubt as to the significance of, or as to the method of determining, any of these items it is suggested that he review the respective chapters in which the direct and collateral costs are discussed.

FIG. 52—SUMMARY OF PHYSICAL PROPERTY OF THE INDEPENDENT HOME TELEPHONE COMPANY

	Reproduction Cost	Present Value
Direct Construction Costs :		
Right of way	$ 2,000	$ 2,000
Land	4,000	4,000
Buildings	25,000	20,000
Central office equipment	25,000	18,000
Subscriber's station equipment	28,000	20,000
Distribution system	120,000	80,000
General equipment	4,000	3,000
Material and supplies	4,500	4,000
Total inventoriable property	$212,500	$151,000
Incidentals and contingencies	6,000	4,200
Warehouse and purchasing expense	5,000	3,500
Tools and tool expense	2,500	1,800
Total direct construction costs	$226,000	$160,500
Collateral Construction Costs:		
General and legal expense	$ 10,000	$ 7,100
Engineering and general supervision	12,000	8,500
Insurance and taxes during construction	2,000	1,400
Interest during construction	12,000	8,500
Total collateral construction costs	$ 36,000	$ 25 500
Total physical property	$262,000	$186,000

Total Value of Property.—Fig. 1, entitled "Total Cost of Plant and Business," gives the total value of the property on a reproduction basis as of the appraisal date. The reproduction cost of

FIG. 1—TOTAL COST OF PLANT AND BUSINESS

Reproduction cost of physical property	$262,000
Cost of franchises	1,000
Cost of establishing business	50,000
Cost of financing	30,000
Working capital	7,500
Total cost of plant and business as of appraisal date	$350,000

the physical property is, of course, obtained from Fig. 52. Cost of franchises, cost of establishing business, cost of financing, and the amount allowed for working capital have all been computed by the methods suggested in previous chapters.

The total value of the property, including the business, is $350,000, and it may be assumed that this value has been submitted to a commission as representing the investment upon which the appraisal engineers feel that their clients are entitled to earn a fair return.

If we assume that the commission before whom the rate case is to be adjudicated has ruled that telephone companies are entitled to a net income of 8 per cent on a fair valuation of their property, the company under discussion should have a net income of about $28,000—8 per cent of $350,000. The next step, therefore, involves a careful analysis of the revenue and expense accounts.

Analysis of the Operating Revenues.—In Fig. 2, entitled "Operating Revenue Analysis," is given a detailed analysis of

FIG. 2—OPERATING REVENUE ANALYSIS

Acct. No.	Item		Revenues
500	Subscribers' station revenues		$50,000
501	Public pay station revenues	500	
502	Miscellaneous station revenues	100	
	Total exchange service revenues		$50,600
510	Toll messages	$ 5,000	
511	Miscellaneous toll line revenues		
	Total toll sevice revenues		$ 5,000
520	Messenger service	$ 50	
521	Telegraph commission		
522	Other telegraph charges		
523	Advertising and printing	200	
524	Rents from other operating property		
525	Other miscellaneous revenues		
	Licensee revenues, Cr.		
	Licensee revenues, Dr.		
	Total miscellaneous operating revenues		250
	Total operating revenues		$55.850

the company's various revenues for the fiscal year immediately preceding the date of appraisal. It has been assumed that the company's books are kept in accordance with the instructions of the Interstate Commerce Commission.

In the first column of Fig. 2 the various account numbers are listed; in the second column, the corresponding descriptive headings used by the Interstate Commerce Commission; in the third column, the operating revenues as taken from the company's books; and in the fourth column, the total operating revenues as subdivided under the three major classifications prescribed by the Interstate Commerce Commission.

It may be well to consider the various operating revenue accounts in some detail before taking up the subject of operating expenses. The operating revenue of a telephone company is divided by the Interstate Commerce Commission into three general classifications—"exchange service revenue," "toll service revenues," and "miscellaneous operating revenues."

"Exchange service revenues" are subdivided into subscribers' station revenues, public pay station revenues and miscellaneous exchange service revenues.

"Toll service revenues" are subdivided into message tolls and miscellaneous toll line revenues.

"Miscellaneous operatng revenues" are subdivided into messenger service, telegraph commissions; other telegraph charges; advertising and directory; rents from other operating property; other miscellaneous revenues; license revenue, Cr.; and licensee revenue, Dr.

Subscribers' Station Revenues.—Under account 500 of the Interstate Commerce Commission's system should be included all revenues derived from the subscribers for strictly exchange service. In other words, it should include the revenues derived from rentals for telephones, extension stations, private branch exchanges, extra listing in directory, etc.

In the case under consideration it will be noted that the revenue from the subscribers' stations is the largest source of income, amounting to $50,000. This is to be expected as the result of our assumption that the company is primarily engaged in giving exchange service, and that the toll service is supplied by a separate company which allows the exchange company only a percentage of the total toll receipts.

Public Pay Station Revenue.—Under account 501 of the Interstate Commerce Commission's account system should be included all revenues derived from exchange service originating at public pay stations. Some companies, the Chicago Telephone Company, for instance, follow the practice of installing coin boxes in connection with the telephones of certain of their regular subscribers. Of course coin boxes used in this way do not constitute public pay stations; they are mere-

ly a part of the subscriber's equipment.

The amount credited to account 501 should be the gross amount collected, including commissions to pay station attendants or others who may be entitled to a commission for making pay station collections. Commissions of this nature are considered as a part of the operating expenses, and will be discussed in a subsequent portion of this chapter.

In Fig. 2 public pay station revenues have been given as $500, a relatively small amount when compared with the subscriber's station revenues of $50,000.

Miscellaneous Exchange Service Revenue.—Under Miscellaneous Exchange Service Revenues, Account 502, should be included all revenues derived from exchange service other than those just considered. In the Interstate Commerce Commission's system of accounting, "miscellaneous exchange service revenues" are divided into four sub-accounts, as follows:

Service Stations, Account 503.

Private Exchange Lines, Account 504.

Minor Rents of Exchange Plants, Account 505.

Other Exchange Revenues, Account 506.

The Sub-accounts of Miscellaneous Exchange Service Revenues.

Under Service Stations, Account 503, should be included switching charges and other revenues derived from equipment owned or partially owned by other companies, and to which the company under consideration furnishes exchange service.

Under Account 504, Private Exchange Lines, should be included all revenues derived from telephone plant leased to others for private purposes, but not connected so as to afford the lessee telephone communication with other subscribers in the system.

Under Minor Rents of Exchange Plant, Account 505, should be included such revenues as may accrue to the company from the lease of ducts in conduit systems or for the use of pole lines.

Account 506, Other Exchange Revenues, should be included all exchange revenues not provided for elsewhere.

No attempt has been made to segregate the various revenues assigned to account 502, Miscellaneous Exchange Revenues, as given in Fig. 2. It has been assumed that a very small revenue—$100—will accrue to the company from one or more of the four sources just considered.

Toll and Miscellaneous Operating Revenues.—The total exchange service revenues, as given in Fig. 2, amount to $50,600 and constitute the principal source of income for the company under consideration. It will be noted that a revenue of $5,000 has been assumed for toll service, and a revenue of $250 for miscellaneous service.

Notwithstanding the fact that these latter sources of reveue are immaterial to our present problem,—inasmuch as we have already assumed that the company whose rates are under investigation is engaged primarily in supplying exchange service,—it may be well to briefly consider the various sources of toll and miscellaneous operating revenue to help the reader in the solution of his own rate problems. Many companies have an appreciable income from the various sources of toll and miscellaneous operating revenue, as listed in Fig. 2.

Toll Messages, Account 510.—Under the account Toll Messages should be included all revenues accruing from messages transmitted over the company's lines between stations located in different exchange areas, and for which a toll charge is made over and above the contract charge for exchange service. To this account should also be charged the proportion of the total toll revenues accruing to operating companies on messages transmitted over toll lines belonging to other companies.

In Fig. 2, it has been assumed that the gross revenue to the company under investigation amounts to $5,000. In this case we have assumed that the operating company does not own the toll lines, and the $5,000 toll revenue, therefore, represents the company's commission on toll business originating with its own subscribers but transmitted over lines belonging to another company.

Miscellaneous Toll Line Revenues, Account 511.—To the miscellaneous toll line revenues account should be charged all toll revenues except those discussed in the preceding paragraphs. In the accounting system of the Interstate Commerce Commission the revenues accruing from miscellaneous toll sources are divided into five classifications, as follows:

Leased Toll Lines, Account 512.

Telegraph Tolls, Account 513.

Telegraph Service on Toll Lines, Account 514.

Minor Rents of Toll Plant, Account 515.

Other Toll Line Revenues, Account 516.

Miscellaneous Toll Line Revenues.—To simplify the problem under consideration it has been assumed that the company does not derive any revenue from miscellaneous toll sources. In fact, our assumption that the toll service is furnished by another company, and that the company under consideration does not own any toll plant, precludes the possibility of miscellaneous toll revenues. The revenues which would ordinarily accrue from the five sources of "miscellaneous toll line revenues" may, perhaps, best be described by quoting the language of the Interstate Commerce Commission:

Leased Toll Lines, Account 512.—This account should include all revenues derived from toll lines (including the terminal exchange circuits) leased by others under contracts giving exclusive telephone use either continuously or during stated periods. Such plant may be leased in connection with private branch exchange or private exchange line installations.

Note: Revenues from private branch exchanges or private lines, the contracts for which provide for the use of toll circuits should be divided (by estimate, if necessary) between exchange revenue and toll revenue.

Telegraph Tolls, Account 513.—This account should include all revenues received from telegraph companies for the use of toll lines for telephoning telegrams and cablegrams.

Telegraph Service on Toll Lines, Account 514.—This account should include all revenues derived from the use of toll lines for telegraph circuits, whether such lines are used by telegraph companies, brokers or others.

Minor Rents of Toll Plant.—Account 515.—This account should include all revenues derived from attachments to toll poles, the use of toll conduits, and other minor rents from toll plant where such property is maintained by the accounting company and the cost of such maintenance cannot be separated from expense of maintaining the rented property. This account should not include rents from equipment leased to licensees under an arrangement for a division of revenues as provided for in account 526, Licensee Revenue, Cr.

Other Toll Line Revenues, Account 516.—This account should include all toll line revenues not provided for elsewhere.

In the May installment the subject of "Miscellaneous Operating Revenues; Messenger Service, etc., etc." will be discussed, and the all important subject of Miscellaneous depreciation, Superintendents, Operators Wages, Supplies, etc., will be dealt with.

Oklahoma District Telephone Meeting

Programs for the first of the 1929 series of district telephone meetings of the Oklahoma Utilities' Association are being completed. A good attendance is expected at each of these meetings, which will be held at Beggs, Tuesday, July 16; Wynona, Wednesday, July 17, and Salina, Friday, July 19. You are especially invited and urged to attend as many of these meetings as possible.

Before the coming of the talking movies and the electric traffic signs the only reading some people did was the titles in the movies and the stop and go signs. Now that these are gone, the last excuse for learning to read has been taken away.

Open Wire Pole Line Construction

By RAY BLAIN

Setting Poles

When it is possible to do so, all crossarms and insulators should be placed on poles before they are set. The crossarms are placed on the pole while it lies in the framing horse, as this gives ample space to drive in the through bolt. If the common 5/8-inch through bolt is used, the hole in the pole should be bored with a 11/16-inch bit. This gives a snug fit and the bolt does not have to be driven in as with the 5/8-inch bit. It will usually require a little driving to force the bolt into the crossarm. The through bolt should be tightened up with the crossarm in its approximate position. To get the top crossarm in its exact position a steel square can be used by placing it on the crossarm and sighting down the long side to the exact center of the pole at the ground line. This method will place the crossarm at exact right angles to the pole which is its correct position. If desired, a lag screw or nail can be driven in the butt of the pole temporarily to sight on. The other crossarms on the pole can be spaced properly by dividing the distance at each end which will place them in line with the first one that was sighted in with the square.

Pole setting is not difficult if proper methods are employed. First the pole should always be raised from the highest ground around the hole if it is located on a slope. If the crossarms are on the pole preferably, they should be on the underside before starting to raise it, otherwise the pole will very likely turn over and may fall, causing injury to some members of the crew. A digging bar should be placed in the hole to guide the pole so that the butt will not catch in the loose earth and prevent the pole from dropping into the hole until it is in a vertical position. On very large or heavy poles the hole should be trenched slightly, which makes their raising easier. Place one man at the bar to guide the butt of the pole into the hole. This man should be armed with a cant-hook, which can be used to pry the pole from one side to the other when it starts to raise so that the butt will be centered on the bar. After the full weight of the pole strikes the bar it will not slide sideways very easily. The cant-hook can also be used to hold the pole should it start to turn sideways. When starting to raise a pole that is at all heavy the top should be lifted and placed on a "pole jenny." If there are crossarms on the pole it will be best to place the jenny just below them for its first position. As the pole is elevated the jenny should be walked forward so as to hold the full elevation when it is necessary to stop and take lower pike holds. Usually a pole can be raised a sufficient height by hand with the help of the jenny to permit the use of short pike poles. The number of pike poles necessary is determined by the size and weight of the poles being set. On small poles none may be needed, on others one may be sufficient, medium size three or four and on large full treated six or eight may be required. Only one or at the most two pikes should be permitted to take a new hold at a time while the rest with the aid of the jenny holds the load. Care should always be taken when pulling a pike out of a pole to lower it for a new hold that it is not dropped on the heads of the workers. There are many clever tricks in pole setting and if the crew with the pikes are well trained and each man does his part it is really amazing how easy it is to set poles even those of oversize and weight. Fig. 1 shows the use of poles

Fig. 1. *Raising pole with pikes and jenny*

and jenny in raising a pole. Pairs of pikes should be set into the pole side and side and about equal distance from the edge of the pole so that the lift will not have a tendency to turn the pole around. When the pole is raising, the man should keep the top of the jenny as close to the pole as possible and always leaning slightly forward so that it will not slip if a sudden strain is placed on it. When the pole is kicked into the hole all pikes should be pulled out or swung sideways to keep the pole in an upright position. In some localities water seeps into the hole between the time it is dug and the time poles are set. All water should be bailed out of holes before poles are dropped into them as it is impossible to tamp a pole solid in wet earth. In swampy ground where it is impossible to bale out the holes, rocks should be tamped in around the poles.

On a deadened pole the crossarms should be placed so that the strain comes on the pole and not on the through bolt. On corners the first pole on either side should face toward the corner. On straight lines the poles should face toward each other as in that way the strain will be divided in case of a break and under normal conditions will be equal. On curves the crossarms should be placed toward the center of the curve.

It was formerly considered necessary to guy each pole on a curve and set the poles so that the strain was equal on each. An improved method is to lay out the line so as to make every second pole a corner.

After the crossarms have been placed on the correct side of the pole the butt should be centered in the hole and four pikes placed at 90 degrees apart around it with the bottom ends kicked into the ground to hold the pole in an upright position. The headliner should sight the pole in the approximate line and then let the sideliner take a look at it from his position. If it is necessary to shift the butt of the pole in the hole a heavy digging bar should be used to kick it over. The cant-hook can be used to pull the pole around until the crossarms are at right angles to the line. The pole should be lined from the side, so that, in the event a plumb line be dropped from the front of the crossarm at the top gain it would strike the edge of the pole at the earth line. The headline should be as straight as possible and this is not usually difficult if the poles are straight. If the poles are crooked and will not line properly the distance should be divided so that the pole or crook does not extend farther on one side of the line than the other, thus providing the best appearance possible. After the pole is lined up from both sides and all pikes kicked in the ground to hold it there the tamping can be started. The proper tamping of the pole is very important if a good line is to be maintained. If the poles are not tamped properly they are usually pulled out of line during the wire stringing.

All men, except the laziest one in the gang, should be given a tamp and he a shovel and cautioned not to rush himself.

On the other hand the men on the tamps can work as hard as they wish and the more pressure on the downward stroke the better. The pole should be tamped evenly all around and after about a foot is tamped in the side and headline should be examined to determine whether the pole is tamping out of line. Any correction necessary can be made easier at this time than after the pole has been tamped in to the surface. Never tamp above the ground level but be sure that the hole is tamped full before stopping. Loose dirt should be tamped down tight for several inches above the ground level so that in case the tamped dirt settles the hole will still be full. If the pole is located in grass or brush it is advisable to bank it 18 inches or two feet high, as this is good fire protection. Poles with butt treatment should never be set or banked so that the untreated part comes in contact with the earth as the treatment will lose its effectiveness and the decay start above it. Never use sod in banking a pole unless it is covered with loose dirt.

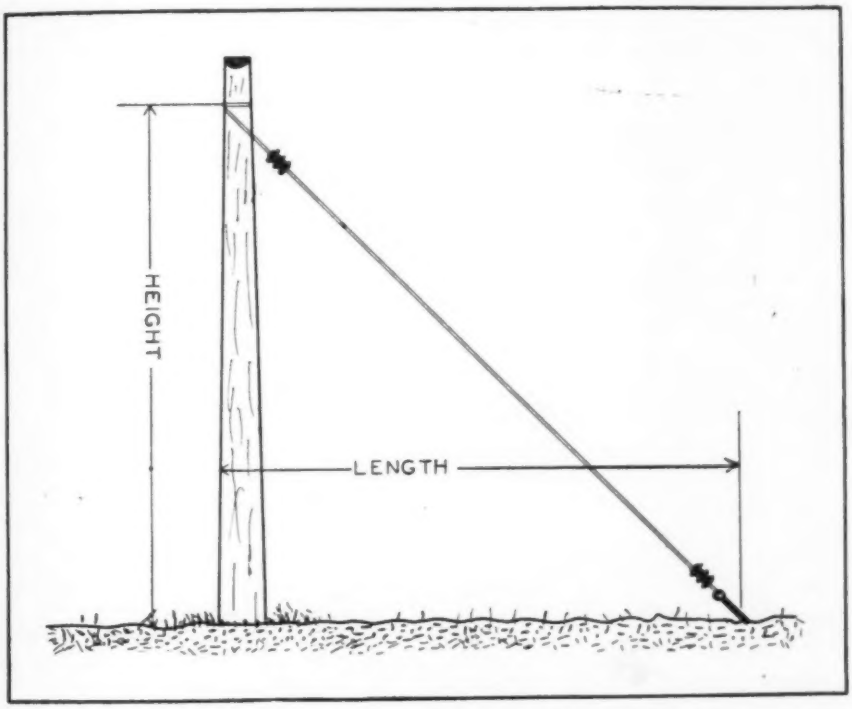

Fig. 2. Method of measuring length and height of guys

Guying the Pole Line

Guys perhaps play the most important part in the construction of a serviceable open wire lead, for no matter how good the material or how well placed in the line it will not give satisfactory service for any length of time unless it is properly guyed at all corners.

If the line is guyed properly and good anchors are set as they should be the line will in all probability stand for years before it will be necessary to pull slack in the line wire. Corners giving away or slacking off is the most frequent cause of trouble in the open wire lead.

Speaking of guys always reminds me of one occasion down in Oklahoma with the old Pioneer Telephone and Telegraph Company just previous to the time that company was adopted by Mother Bell. In those days it was not always customary for the line foreman to render daily reports. If any of the officials wanted to know what was going on they usually went out on the line and looked things over. Some of the hard shell foremen resented the fact that the changing organization called for a daily work report and they didn't always get them into the district office in the required form. One particular foreman having been reprimanded on the matter decided that he would reform and give them a detail report of a day's work setting storm guys and this report for detail and brevity rivals that of Flannigan's train wreck report. "Hung one guy; took down one guy; rained and the guys all went home."

The distance from the pole along the ground to the anchor rod at the ground level will in this article be called the "Length." The distance from the ground level to the point where the guy is attached to the pole will be called the "Height." (See Fig. 2.) When possible, anchors should always be located with a length of not less than the height, and ordinarily with a length of more than one and a quarter that of the height. The closer the anchor is placed to the pole the greater will be the strain on it. However, the reduction of the strain on the guy by increasing the length over one and one-quarter times the height is so slight, the gain is offset by the fact that the longer guy is more exposed to mechanical injury.

There are many different ideas about proper location of guys on various types of corners. For the right angle corner it was formerly considered necessary to use two guys placed directly in line with the pull each way. It is now considered good practice by many construction men to place one guy directly between the two pulls as shown in Fig. 3, provided that the strain is equally divided between three points. This type of guying seems adequate except in some cases it may be necessary to place a temporary guy on a corner of this type while pulling wire or until the strain is placed on the corner from each direction. It will be noted that most radio or other high poles are not guyed except on three points and few of them ever cause trouble. On a right angle corner if two guys are used they will be 90 degrees apart and if the one guy is used it will be 45 degrees toward the center from each. The same rule holds true regardless of the angle of the corner and any angle less than a right angle seldom has need for more than one guy. Care should always be taken to place the guy directly between the two pulls as shown in Fig. 4, for if it is not, the pole will be pulled either forward or backward when the strain comes on the guy.

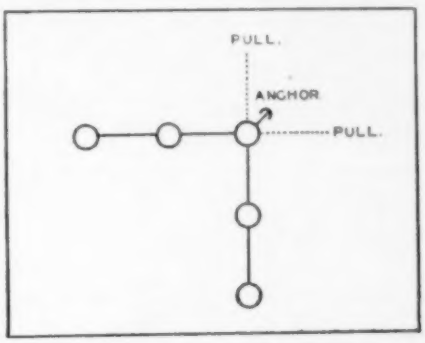

Fig. 3. Location of single guy of right angle corner

Buck-arm corners are in general disfavor as they are expensive and usually a constant source of trouble. I have even known of linemen that would swear when required to work on a large buck-arm pole. No matter how the jumpers are run on one they are always in the way. Two pole corners guyed at the proper angle solves the problem in a simple manner. When it is necessary to branch off from a main lead at right angles and the two pole method cannot be used, believe that it is better to dead-end the open wire on the first pole on the branch line and extend to the main line with twisted pair in the form of a lock-aerial to avoid a buck-arm.

When it is necessary to change sides of a road with a line to avoid trees or

for any other reason, the two-pole method can be used but it is generally best to use two guys per pole.

Messenger strand about 3/8 inch galvanized, never smaller should be used for open wire guying. Guy clamps permit a cheaper and quicker job plus the advantage that they can be taken off and reused if it is ever necessary to tighten a guy. If servings are used instead of

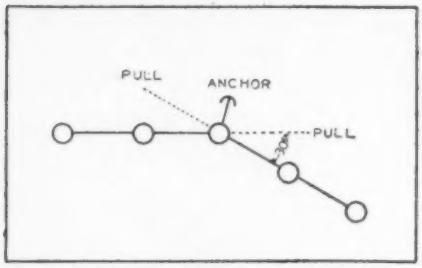

Fig. 4. Location of anchor on corner less than a right angle

clamps a new piece of messenger is generally necessary if a guy needs to be repulled. Strain plates, to prevent a guy from cutting into the pole where the wrap is made, while not absolutely necessary are always advisable except on a lead of one or more circuits where there is no possibility of more ever being added. On a heavy lead it is best to use guy hooks (sometimes called "J" hooks.) to prevent the wrap from slipping down the pole. On a small lead or for storm guys on a large one, lag screws can be driven into the pole on a slant to answer the same purpose.

The neck of the guy, that is the distance from the pole to the first guy clamp should be at least the diameter of the pole at the wrap.

When distributing poles along the line

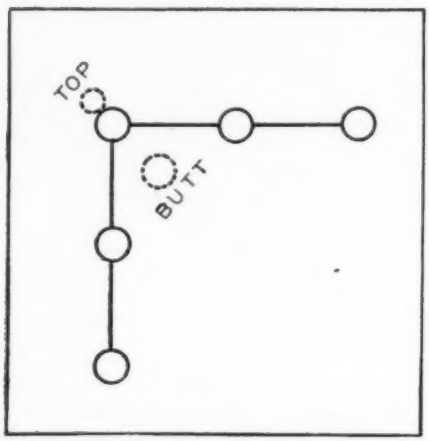

Fig. 5. Method of raking poles on corner

the largest and best should be selected for locations that will carry the greatest strain. All deadened and corner poles should be raked if possible. By rake we mean that the butt of the pole (see Fig. 5) is set in from the line about one foot for each 20 or 25 feet of height. Guyed poles should always be pulled out of line at the top a distance equal to their diameter to allow for settling of the pole and anchor. This amount will usually permit the corner to come in exact line in ordinary earth. If the earth is especially soft then a greater allowance should be made.

Guy thimbles should always be used on the anchor rod to prevent the messenger strand from flattening when the guy is pulled tight. The new style anchor rod with the special shaped eye accomplishes the same purpose without the use of a thimble.

The eye of the anchor rod should always be kept five or six inches above the ground level. If the eye becomes covered with earth a local action can take place from certain chemicals which the soil may contain, which has been known to weaken a guy and in some cases cause its failure.

On head guys where the lower end is fastened to a pole or tree instead of an anchor, the point of contact should be at least eight feet above the ground level to provide ample clearance.

I consider it good practice to place a strain insulator in all guys. An accidental contact between a power circuit and a guy that is not insulated will in many cases cause considerable damage. Insulators will in many cases prevent a case of trouble when a guy slacks off and comes in contact with a line wire.

Annual Convention of U. S. Independent Telephone Association to Be at Stevens Hotel

Announcement has been made that the 33rd annual convention of the United States Independent Telephone Association will be held at the Stevens hotel, Chicago, beginning Tuesday, October 22nd. As usual the convention will cover a period of four days.

The change was made on account of the fact that more space was available at this hotel for exhibits and sessions and the accessibility of the exhibition hall.

Those desiring exhibit space at the Stevens hotel during the convention may secure floor plans and general information from TELEPHONE ENGINEER or writing the president or secretary of the United States Independent Telephone Association, 19 South LaSalle Street, Chicago.

Northern Indiana Association Holds Annual Convention

The annual convention of the Northern Indiana Telephone Association was held at Lake Wawasee, Syracuse, Indiana, June 25th, 26th and 27th. The meeting was held at South Shore Inn, one of the beauty spots of Indiana.

Aside from the technical discussions, addresses by C. Perry Gibbs, of Warsaw, subject: "My Old Kentucky Home," and W. S. Vivian, of Chicago, subject: "Humanics," featured the program. Vivian is a good drawing card any time, but this time he seemed to be at his best.

"Making the Telephone Business Pay," by C. R. Hurmence, of Elkhart, was another very able discussion of the every day problems confronting the industry. Other discussions made up a very interesting program. Several new faces were noticed and introduced by the president.

The operators held sessions and discussed questions affecting their part in furnishing service to the public.

The following officers and directors were elected for the year: Roscoe Pontius, president (re-elected); C. R. Hurmence, Elkhart, vice-president; secretary-treasurer, J. T. Stoops, Nappanee; directors, C. R. Hurmence, Elkhart; Chas. Koontz, Bremen, and Sam Tomlinson, Winona.

Phone Connection Charge Under Probe

Indianapolis, Ind.—Investigation of the necessity for telephone companies to make a "connection" charge against new subscribers has been started by the public service commission through its engineering department.

Since the public service commission came into existence, telephone companies have been permitted to levy a "connection" charge against all classes of patrons, the rate for residence telephones generally being 50 cents. Other connection charges in classifications of business telephones and trunk lines with private branch exchanges have ranged to $3.50 for companies having more than 10,000 subscribers and as high as $2 for companies of fewer subscribers.

Small telephone companies frequently have received authority from the commission to suspend the connection charge while campaigns are conducted for new subscribers. The connection charge always is a factor in the determination of telephone rate cases.

LINE AND DESK

THE VALUE OF ROUTINES IN PLANT MAINTENANCE

The great increase in the use of the telephone as a means of communication has made necessary a vast amount of outside plant construction, as well as the installation of much inside equipment, in order to take care of the demand for telephone service. Along with the great increase in the amount of plant to be cared for by the maintenance forces, new standards of performance have been set up, and more refined methods of operation are being used. The growing use of long distance service makes every telephone a long distance telephone, even to those in the more remote sections of the country. Dut to these facts, more efficient maintenance methods must supplant the more or less haphazard methods of the past. In order to effect the greatest economy of effort and reduce out-of-service troubles to a minimum, maintenance men should work with a well defined purpose in view.

Success in telephone work, the same as in other things, is the result of systematic and persistent endeavor. To assist plant men in systematizing their work, routines for the regular performance of certain tests and inspections have been set up by the larger companies. With many of the smaller systems, men work without the supervision of experienced men to guide them. This means that they must apply their own efforts to working out a system for keeping up with their work.

Work done on routines is preventative maintenance; that is, it catches the trouble before the equipment affected is out of service. The old adage, "an ounce of prevention is worth a pound of cure," would have originated in telephone circles had it not been so universally true that somebody else thought of it a long time before the telephone was invented. Everyone who knows what a job it is to restore a line after a pole line failure will agree that it is much easier and cheaper to reset or replace poles while the lead is standing than to have to pick up an open wire or cable lead out of the street. In addition to the extra work, the interruption of service is often the cause of much dissatisfaction on the part of subscribers. This, of course, is an extreme case, but the earlier any bad condition is taken care of, the better.

Poles, arms, guys and anchors should be inspected often enough to insure their safety. Line wires should be inspected for improper sag, broken or missing insulators, and clearance from foreign wires. Highway and railway crossings should be inspected at least annually to see that proper clearance is maintained and if line wires, arms, poles and anchors are in safe condition.

The central office equipment should be inspected frequently. Loose fuses, unsoldered or poorly soldered connections on the main frame will be found on this inspection if such exist. If one has not gone over his main frame for a while, he is often amazed to find many possible causes of trouble that he didn't know were there.

The ringing equipment, regardless of whether it is a hand generator, some kind of a ringing machine, or both, should be kept in proper working condition. Operators' sets and circuits should be tested. Cord circuits should be tested for continuity, ringing, and supervision, and cut-outs cleared up. Plugs and jacks should be inspected for wear, and those showing excessive wear should be replaced. Plugs should be kept clean and bright by the use of a plug polishing paste which is made specially for that purpose. Night alarm, trunk, and miscellaneous circuits should also be tested for proper operation. To keep this article from being too lengthy, a description of the tests and inspections outlined above is not given in detail.

An inspection of a portion of the subscribers' sets each month, especially those having much use, will keep down trouble and make friends. Many people hesitate to report a small matter, but are not slow to express their appreciation when you come and fix it without their having to call the repair department.

By properly directing his efforts during his optional time, a man can always get ahead of his trouble. If he waits until he has trouble reported to him, his trouble will often get in the lead.—Contributed by W. C. White.

TO AVOID BLASTING, POLES ARE SET ON TOP OF GROUND

An interesting type of construction employed by a Connecticut electric company is described in a recent number of *Wood Preserving News*. The line under construction consisted largely of H-frame structures built of creosoted yellow pine poles 45 to 60 feet in length.

The country traversed by this line consists of marshes, with stretches of rolling ground, cut at intervals by high

Because of the expense of blasting holes in the rock these creosoted pine poles were set with mounts bolted to the solid rock

ridges or dykes of solid rock, offering many difficulties both to distribution of material and to construction. Across and along these solid rock outcroppings holes could not be dug except by blasting for the entire depth. This would have involved a considerable expenditure for labor and explosives, as well as expensive transportation of compressor and drill equipment. In order to surmount this difficulty, the superintendent of lines conceived the idea of utilizing cast pole mounts, which he had formerly employed to some extent in resetting untreated poles which had rotted at the ground line. The pole mount consists of two

upright castings with convex faces between which the pole butt is set and clamped by three bands or hoops. The mount is held securely in place by anchor bolts through the base into the rock or concrete foundation.

Preparation of the mount location consisted of leveling a sufficient area on the rock ledges to found the base of the mount, and drilling the four holes required for the anchor bolts. The anchor bolts were then set in the holes and grouted in place. Slotted anchor bolt holes in the base of the castings facilitate the ready adjustment of the mounts to varying sizes of poles. Grouting was done sufficiently in advance of pole erection to allow the concrete to set and acquire the desired strength.

MINOR INJURIES

We ask all employes to treat all injuries with first aid, no matter how slight the injury may be, and in case of any doubt, to see a doctor. By all means, report the injury to your department head.

The company provides facilities for such treatments, and expects all employes to live up to this simple rule so as to avoid infection.

The penalty for violation of this rule is best known by the employe who has had an infection and suffered as a result.

No one knows where an infection will stop when it once starts.

All hazardous conditions should be cared for at once. Ladders, ropes and tools should be inspected frequently, and in case of defects, the department head's attention should be called to them immediately.

Our records show that a large part of our accidents are due to unsafe practices.

A foreman can greatly reduce the number of accidents in his division by correcting unsafe practices before they cause accidents.

The man who does his work in an unsafe manner after being shown how to do his work safely by his foreman is subject to discipline.

You owe it to yourself, your family and your community to do your work safely. Think it over.—H. A. Mott, in *Bell Telephone News.*

European Countries Show Unusual Telephone Activities

Progress in European telephone modernization is reflected in cables made public July 10 by the International Telephone and Telegraph Corporation. The cables report activity of associated companies in foreign fields.

A contract has been secured by the Compagnie des Telephones Thomson-Houston Paris affiliate, whereby the French Telephone Administration agrees to place orders to the extent of 40,000,000 francs during the next three years for a new type of central office equipment. This modern equipment is to be installed in cities other than Paris, where another associated company of the International System, Le Material Telephonique, is already supplying the French capitol with rotary automatic telephone equipment. Installed by Le Materiel Telephonique, another large automatic rotary telephone exchange was opened in Paris July 6, serving 10,000 lines.

Alexandria, Egypt, is improving its telephone system, municipal authorities having placed an order for rotary central office telephone apparatus for 20,000 lines with Standard Telephones and Cables, an associated company in London. The same member of the International System is already furnishing similar automatic equipment to modernize telephone service in Cairo. The Egyptian State Railways have also recently placed an order with the same company for a long distance telephone switchboard.

Standard Telephones and Cables is also receiving a number of orders indicating further extension of long distance telephone service on the Continent. It has contracted to furnish loading coils for a long distance telephone cable between Bologna and Ancona in Italy; loading coils and repeaters for the line linking Warsaw, Lowice and Lodz in Poland; and loading coils for a cable connecting Copenhagen and Nykopingf, ordered by the Danish Telephone Administration. An allied cable manufacturing company in Denmark is filling the order for 124 kilometers of cable for the latter contract.

In Spain last week the ancient city of Granada inaugurated an automatic telephone system with official ceremony. It is part of the national service operated by the Compania Telefonica Nacional de Espana, an associated company.

Standard Villamossagi Resveny Tarsasag, an associate company of International Standard Electric Corporation, near Budapest, has developed a new multiplex telegraph exchange for the Hungarian Post Administration that has proved so satisfactory that a further order for 25 operator positions has been received. The Hungarian State Railway has also placed with the same company an order for a 100-line extension of their automatic telephone system.

Creed & Co., another I. T. T. associate, is filling an order for telegraph printers received from the London, Midland, and Scottish Railway.

South American Radio-Phone Service to Open

Lawrenceville, N. J.—Plans for the expansion of the trans-Atlantic radio-telephone service to include the larger South American countries were disclosed by the American Telephone and Telegraph Company simultaneously with the opening of the first of four new short wave beam stations about a mile from here June 20th.

The stations, atop of a high hill and visible for miles around, form part of the equipment for trans-Atlantic radio service and, when completed, will make available three channels for service with Europe and one direct with Argentina. Service on the trans-Atlantic telephone, according to an official of the telephone company, has increased so rapidly since its inception in January, 1927, that the new stations here were erected to permanently establish communication between America and the important centers of Europe and South America.

Service with Argentina will be inaugurated upon the completion of the other transmitters, about September 1. The beam transmitter opened recently serves as a channel for direct connection with London, where it is possible to connect with all of Europe by land wires.

Lawrenceville, a short distance south of Princeton, was selected as the site for these four radio telephone transmitters after extensive investigation, according to engineers. Equipment is housed in two buildings, located about a mile apart. The antennae for the three short-wave systems to Europe are in a direct line, supported by nineteen steel towers at 250-foot intervals. These towers stand in line as nearly exactly at right angles to the direction of New Southgate, England, the location of the London receiving station, as surveying permits. The wires forming each of the three antennae are not strung on top of the towers, but, like a meshed screen or curtain, hang in a vertical plane between the towers, the lower edge of the screen coming within several feet of the ground. The series of seven towers for South America stand at right angles to the direction of Argentina.

The design of the antennae is calculated to give a marked directional effect to the outgoing signal, engineers say. Due to the arrangement and interconnection of the wires, the form of cross-meshed screen or curtain, dimensions of which bear a definite relation to the wave length, impulses sent out, the signals are the strongest in a direction at right angles to the plane of the curtain.

Each of the new transmitters may operate on three wave lengths, approximately 16, 22 and 33 meters. All four

(*Continued on page* 44.)

Thousands of improvements in central office equipment in 5 years

An Advertisement of the
American Telephone and Telegraph Company

In the last five years there have been hundreds of improvements of major importance in telephone central office equipment in the Bell System, and lesser improvements by the thousands. Improvements have been made in switchboard cable, in relays, in cords, in condensers, in selectors, and in the development of new and better materials for all kinds of equipment used in the central offices.

These improvements have not only helped to meet the steadily increasing complexity of telephone requirements. They also make possible the high-speed service which is eliminating delay from the personal contacts of people anywhere in the United States, whether they be separated by three floors of a building or three thousand miles of country.

There is no standing still in the Bell System. Better and better telephone service at the lowest cost is the goal. Present improvements constantly going into effect are but the foundation for the greater service of the future.

Ramblings

By J. A. S.

Clarence B. Randall, vice-president and general counsel for the Tri-State Telephone & Telegraph Company, St. Paul, Minn., was recently elected president of the St. Paul Association, a civic organization of that city. Mr. Randall has been active in telephone affairs of the nation for a number of years, and his ability is unquestioned. Verily, "a prophet is not without honor save in his own country" does not apply to Randall.

* * *

Here's a record for continuous service that is hard to beat. Capt. J. B. Featherstone, supervisor of buildings and vehicles of the Southern Bell down in Louisville, Ky., recently celebrated his fifty-fifth year with that organization. He was presented with a gem-studded emblem by the J. B. Speed Chapter, Telephone Pioneers of America, on the occasion, Ben. S. Read, president of the Southern Bell, making the presentation. Featherstone holds the record for length of continuous service in that organization.

* * *

Jack Coffey, Indianapolis; Ed (Pop) Shade of Johnstown et al. are supposed to be in the Lake o' the Woods, Canada, for a ten-day outing. This is an annual jaunt of many years' duration, and has been passed up very few times by these sons of toil.

* * *

The Highway Trailer Company, Edgerton, Wis., recently shipped some of their heavy equipment to Russia. They are completing an order for sanitary trucks for the city of Cincinnati. Other orders for heavy machinery are being turned out by this very busy manufacturing plant at Edgerton. We can well understand how Cincinnati and Chicago can well use many steel trucks for their sanitation, and how Abilene, Kans., can profitably buy one of the large earth-boring machines for their telephone construction department, but just how one of these large machines that makes post holes in wholesale lots is needed in Russia we do not know. Had this manufacturer of heavy hardware invented a two-foot razor and succeeded in selling a carload in Moscow, we would not have marveled one minute. We are pleased to know that Russia is adopting modern methods in telephone construction, and glad, also, that the order came to this manufacturer of high-class machinery.

* * *

According to a story appearing in *Popular Science* for June, a specialist in home economics at the University of Washington has developed a new method of cooking, in which electric current passes directly through the food. It is said that a potato can be baked in one minute, and an egg fried in two seconds. O, woman, where is thy job?

* * *

Florida Telephone Corporation
Otto Wettstein, Jr., Pres.
Leesburg, Florida

June 26, 1929.

Mr. J. A. Smith, Chicago, Ill.

Dear Mr. Smith:

If you were inspired by the pictures of the Bok bird sanctuary and singing tower, it would indeed be a pleasure to show you the original and many other beauty spots in our wonderful state.

I am glad to know you are for the visit, so crank up the Lizzie and come on down now and enjoy our wonderful summer resort weather and get some relief from the stifling heat of Chicago, which I know all about for I lived at Rochelle, only 75 miles away, for 22 years—the first of my life.

A few tanks of gas will get you here in four days over fine roads, and you will say that Florida is the place to go for a summer vacation.

Make Leesburg your headquarters, and we will be pleased to show you around. Very truly yours,

OTTO WETTSTEIN, JR.

* * *

We spent the last week of June down at Wawasee Lake, Indiana, where fish are large and stories in proportion; we did not bring any fables back with us. In fact, we turn a deaf ear to such desecrations of the Izaak Walton art. We only took the fish the wife caught, without asking her just where she caught them, and were thankful for the large number found each evening upon our return from the convention of the Northern Indiana Telephone Association, held at Lake Shore Inn, located on the banks of Indiana's second largest lake. We were content to enjoy the pound-size bluegills, while others, not of our clan, told of the two-foot bass caught with pin hooks and bare hands. Anyway, a fish in the pan is worth two in the telling.

* * *

And the practical joker was at the convention to knock on the doors of those whose heavier duties of keeping up their end of the golf score found them exhausted, at 5 o'clock in the morning, and informing them that the last guest was in bed and they could go to sleep without being disturbed.

* * *

Roscoe Pontius of Rochester, Ind., who piloted the district convention of telephone interests in the northern half of Indiana to a successful year of activities, was re-elected president for another year.

Ray Smith of Fort Worth, Tex., attended the Memorial Day auto races at Indianapolis May 30th, coming to Chicago from there to visit his dad. While in Chicago he purchased the interest of his father in the *Transmitter-Journal* at Fort Worth, and will pilot that publication in the future. *Transmitter* was established a quarter century ago, and has belonged to the Smiths (Aaron and J. A.) and has been operated by one or the other of them during its lifetime. Now it passes on to the son, and we predict another quarter century of activities.

* * *

Times change, likewise conversation and discussion at telephone conventions. In "the good old times," as we are wont to say, the general topic of discussion was "cussing the Bell"; then came the period of working out the problems of the telephone business in a sensible and systematic way. Later on, probably shortly after the war, long and earnest discussions were indulged in, and the words "hops," "sugar," "malt," etc., were freely used. This subject was evidently settled to the satisfaction of all for it is seldom heard now. The past few years one hears discussed the subject of golf, vacations, etc., indicating that the business is now one of the prosperous vocations of life. While side issues have constituted part of each convention, the subject of better methods of giving service and making the business pay have predominated, and the evolution of the industry during the last twenty years has been marvelous.

* * *

P. Kerr Higgins, that hustling manager of the Scotia Telephone Company with headquarters at St. Louis, certainly has an itching foot this summer. He returned the first of the month from an automobile tour through the West, reaching the Pacific coast, and covering 7,000 miles. Not content with his home town after this ramble, he hikes right off for points in Ohio. In the name of the funny paper, "can you beat it?"

* * *

In our ramblings over the country we have invariably found H. E. Billington, of the Kellogg Switchboard & Supply Company at the different state conventions, meeting the trade and gathering data as to conditions in each section. Since his connection with this well known manufacturing enterprise, Billington has added hundreds of friends to organization.

* * *

And the Stevens Hotel will play host to the National and Independent Pioneer conventions this year. Seems like deserting the old home to pass up the Hotel Sherman. But times do change; doubtless the Stevens offers better facilities.

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Introduction

One of the important developments in telephone engineering during the last decade has been the practical application of high-frequency currents for the transmission of telephone and telegraph messages over circuits simultaneously carrying other traffic. For the transmission of speech by this method, the band comprising the frequency components in the voice of the speaker, which in the ordinary telephone circuit is transmitted by electrical currents of the same frequencies, is translated into a band of high frequency currents. These high-frequency or "carrier" currents are above those transmitted by the ordinary voice-frequency channel, and so may be sent over a pair of wires that is being used for the transmission of speech frequencies. At the receiving end, the bands of high-frequency currents are separated from each other and from the voice currents on the same pair of wires by electrical filters, so that each delivers its message independently.

Since 1918, the date of the first commercial installation of carrier telephone equipment, engineering and installation of carrier systems has progressed steadily. In the paper on *Carrier Systems on Long Distance Telephone Lines*,* it was shown how developments of recent years have greatly extended the use of carrier telephony on the longer circuits in the Bell System. There is also a considerable field of use for carrier telephony on the shorter open-wire toll circuits; that is, those ranging upward from about 50 miles in length. The type D carrier telephone system has been developed to fill this need.

General Arrangement and Functioning of System

In order to provide a carrier system which would be sufficiently low in first cost and maintenance to effect economies when used in place of wire construction for these shorter circuits, special consideration has been given to reducing the amount of apparatus required and at the same time providing a system of such stability that very little maintenance would be required. This has been accomplished by making the system a single-channel system,—one which provides only one additional talking circuit per pair of wires,—by employing comparatively low carrier frequencies, and by including several new design features. The provision of only a single channel results in a simpler and less expensive design for the filters; the use of low carrier frequencies results in decreased line attenuation and reduces the cost of line transposition and carrier loading which may be required; while the new design features are of such a nature as not only to simplify the apparatus but to increase the stability of the circuit as well. Daily adjustments necessary with carrier systems operating over greater distances have been eliminated. The complete equipment for each system terminal is assembled as a unit which is wired and tested at the factory before shipment, thereby reducing engineering and installation costs.

The new electrical features which have been incorporated in this system consist principally of (1) the use of an arrangement for producing carrier current whereby modulators and demodulators are self-oscillating; that is, the same vacuum tubes function both as oscillators and modulators or as oscillators and demodulators, thus economizing in the use of tubes and power; (2) the use of a new method of modulation and demodulation requiring the expenditure of a relatively small amount of plate battery power; (3) the elimination of grid batteries in the modulator and demodulator circuits by the use of grid current to produce grid biasing voltage; (4) the use of the modulator-oscillator circuit as a source of signaling current supply; and (5) the use of a ballast resistor to maintain the filament current within suitable limits. These new arrangements have resulted in economy in equipment as well as in a system of high stability. Economies also have been effected by the use of improved types of paper condensers in place of mica condensers in certain parts of the circuit, and by the use of unpotted coils where the requirements are such as to permit of this being done.

Like other recent carrier systems, this one uses different high-frequency bands for transmission in opposite directions. It is a carrier suppressed system, and a single sideband only is transmitted. As shown in Fig. 1, the lower sideband of a carrier of 10,300 cycles is used for transmission in one direction, and the lower sideband of a carrier of 6867 cycles for transmission in the opposite direction.

The type D carrier telephone system has been provided in two general arrangements; the first employs certain basic equipment only and is suitable for operation over circuit lengths up to about 125 miles; the second employs the basic equipment together with terminal amplifiers and other additional equipment and is suitable for use for circuits up to about 200 miles in length. The latter arrangement, which is known as the type D-A system, is also used in some cases for circuits under 125 miles in length in order to equalize transmission levels with respect to those of other carrier systems operating on the same pole line. This is sometimes necessary because the normal levels of long-haul carrier systems are higher than those provided by the type D system without an amplifier. Also, there are certain circuit layouts involving type D systems only, which may require level equalization by means of the amplifier.

A schematic of one terminal of a basic type D system is shown in Fig. 3. When subscribers are connected to the

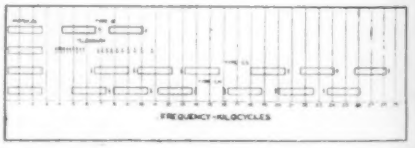

Fig. 1—Frequency Allocation of Type D System

two terminals of the carrier circuit, speech frequencies from the talking subscriber pass into the hybrid coil, and are impressed upon the grids of the modulator tubes. The application of speech frequencies to the modulator, with carrier frequency present, results in modulation, the principal products of which are the upper and lower sidebands. By means of the balanced connection of the modulator output transformer, the carrier frequency is almost entirely suppressed and only a negligible amount appears in the output circuit. The output from the modulator passes to the modulator band filter where the upper sideband and other unwanted frequencies are suppressed and the lower sideband is permitted to pass on to the line through the high-pass line filter. The low-pass line filter prevents the high-

*Carrier Systems on Long Distance Telephone Lines, by H. A. Affel, C. S. Demarest and C. W. Green. October Trans., Quarterly, 1928, A. I. E. E., p. 628.

Abridgement of a paper presented at Pacific Coast Convention of the American Institute of Electrical Engineers, Spokane, Wash., Aug. 28–31, 1928.

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frequency current from passing at the local terminal to a subscriber who may be talking on the voice-frequency line circuit on which the carrier is superimposed.

At the receiving terminal, the transmitted sideband passes through the high-pass line filter and the demodulator band filter to an input transformer which impresses it on the grids of the demodulator tubes. Application of these sideband frequencies to the demodulator, with the carrier frequency present, results in a reproduction of the voice frequencies applied at the sending end. The various undesired high-frequency currents present in the output of the demodulator are suppressed by the low-pass filter in the output circuit. The voice currents pass to the hybrid coil and thence to the switchboard and the listening subscriber.

ing the plate current. The result of a mathematical analysis of this portion of the grid voltage is shown in Fig. 32. This figure is a diagram of voltages, which, if applied to the grids as shown, would produce the same result in the plate circuit as the carrier and voice voltages actually applied. The frequencies that are important in controlling the production of sidebande differ from those in the older types of modulators. In this case, for maximum efficiency the load impedance should be zero at all frequencies except the sideband desired, at which frequencies it should equal the resistance of the tubes at the operating point. A full description of the theory of operation of these circuits is given in the complete paper.

The arrangements for signaling are also shown in Fig. 3. The method of signaling is similar to that employed in

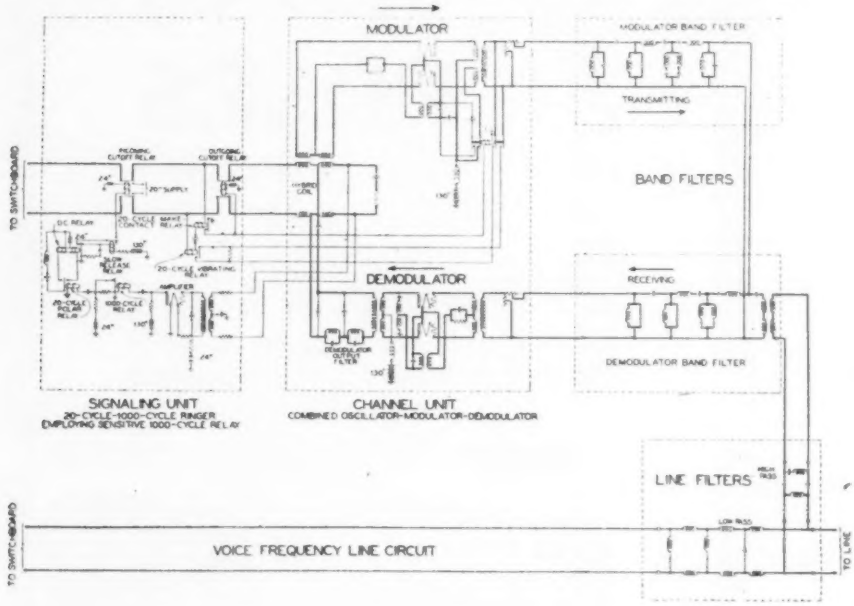

Fig. 3—Schematic of Terminal of Basic Type D System

The design of the modulator and demodulator circuits is such that a novel and original scheme of modulation and demodulation results. Grid biasing voltage is obtained by rectifying in the grid circuit a small portion of the applied carrier wave. The two tubes oscillate in parallel, the amplitude of the oscillations being controlled by the design of the oscillator coil instead of the usual feed-back risistance, and the portion of the carrier wave rectified is sufficiently small so that the grid biasing voltage is nearly equal to the peak value of the oscillations. Referring to Fig. 26, it will be seen that the grid biasing voltage for the modulator is — 100 volts, whereas, the usual grid voltage, if this type of tube is operated as an ordinary plate circuit modulator is — 18 volts. Due to this high negative grid potential, only a portion of the carrier and voice voltages applied to the grids is effective in varying the 1000-cycle signaling system used on wire circuits. It differs in that signaling current is obtained by changing the connections of the modulator during the ringing period so that a separate source of 1000-cycle signaling current is not required. In order to signal over the carrier circuit, the modulator is unbalanced and the oscillator frequency reduced by 1000 cycles. The resulting high-frequency output is then interrupted at a 20-cycle rate. The receiving portion of the signaling circuit consists of an arrangement designed to respond to 1000-cycle current interrupted at a 20-cycle rate.

Transmission Considerations

The use of relatively low carrier frequencies has been an important factor in effecting economies. Low carrier frequencies, in addition to reducing the amplification which the equipment must provide, insure better transmission stability over the line. Low carrier frequencies reduce the carrier loading and line transposition which may be required. Representative transmission characteristices of the band filters and line filters are shown in Fig. 11.

The high degree of inherent stability which has been secured in the design

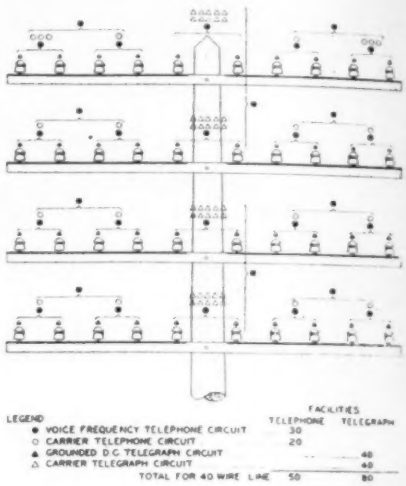

Fig. 6—An Arrangement of Communication Facilities on Pole Line of Four Crossarms

of the system has made it practicable to omit apparatus for the adjustment of amplification, frequency, and filament current usually provided with carrier equipment, thereby simplifying the system and reducing its cost. The variations of transmitting and receiving amplification with plate battery fluctuations from 125 to 135 volts are not more than 0.1

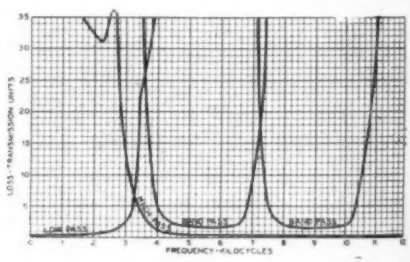

Fig. 11—Representative Filter Transmission Characteristics

TU. Variation in transmitting and receiving amplification with filament battery fluctuations from 20 to 28 volts are even less. Combined transmitting and receiving amplification changes with tube changes do not exceed approximately 1 TU. These are, however, of lesser importance as tubes are changed very infrequently. This high degree of stability results from the self-compensating properties of the self-oscillating circuits.

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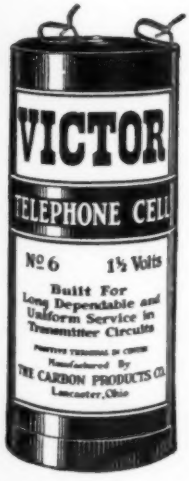

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line. This system provides for the use of type D carrier systems on as many as four crossarms. When it is applied to lines on which no other type of carrier facility will be operated, it permits

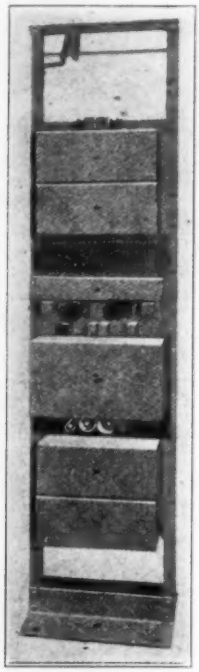

Fig. 13—Typical assembly of Type D Carrier Terminal on floor mounted rack

the use of basic type D systems on all pairs with the exception of the pole pairs. With slight modifications, it provides for the operation of two three-channel type C-S carrier telephone systems[3], one system on each of the outside phantom groups of the top arm, and, in addition, either a carrier telegraph of a type D-A carrier telephone system on the other pair of each of these phantom groups. Type D-A systems may also be operated on all other pairs of the line except on the pole pairs. Carrier telegraph systems may generally be operated on one or more of the pole pairs. The former transposition arrangement for the basic system, therefore, permits the operation of a total of 16 type D systems on a four-arm lead, and the lattter arrangement with the long-haul systems permits the operation of two three-channel carrier telephone systems, 14 type D-A systems, and, in favorable cases, four 10-channel carrier telegraph systems on the same number of pairs, in addition to the grounded d-c. telegraph and the telephone facilities ordinarily obtained. Fig. 6 illustrates the relative positions of these facilities on the four crossarms.

Equipment Features and Typical Installations

The equipment for the basic type D system has been divided into five principal units; the signaling unit, channel unit, modulator band filter, demodulator band filter, and line filter set. The apparatus for each of these units is assembled on a panel 19 inches wide and of sufficinet height to provide the required mounting space. These panels are mounted on a rack and wired together, the leads which go to points outside of the bay being wired to a terminal block located at the top of the rack. The wiring required at the time of installation consists only in cabling from this terminal block to the distributing frame and to the sources of power supply.

A typical assembly of a type D carrier terminal is shown in Fig. 13. This arrangement employs a floor mounted rack approximately 7 feet high and includes all of the equipment comprising the carrier terminal with the exception of the power supply. The two box-like units near the bottom of the rack are the band filters. Directly above the band filters are the channel unit, signaling unit, relay adjusting unit, and jack panel, in the order named. Above the jack panel are the line filters and certain balancing equipment which is required when voice repeaters are used on the voice-frequency circuit on which the carrier system is superimposed, or on the circuit obtained by the carrier system. This particular assembling is of advantage in temoprary installations and in offices of low ceiling heights. Where greater economy in floor space is desired, an assembly which provides the equipment for two type D carrier terminals on a rack 11½ feet high is used.

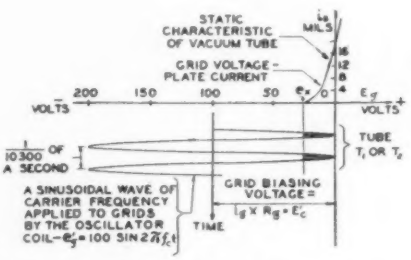

Fig. 26—Approximate Relation of the Tube Characteristic to the Grid Voltage in the Self-Oscillating Modulator of Fig. 21. No Speech Input

Similar assembly arrangements are provided for the type D-A system. In this case, an amplifier and an auxiliary filter panel are required in addition to the apparatus listed above.

Due to the features of its design and arrangement whereby it may be furnished as a complete self-contained equipment requiring relatively little engineering and installation work, the type D system is useful in providing facilities quickly, and, where temporary facilities are required, is capable of being readily moved from one location to another. This has already proved to be an advantage of some importance to the telephone companies. The establishing of facilities on an emergency basis during the recent flood in New England is one example of this sort. Another occurred in New York State when after a line break had interrupted service over the normal route, two terminals were transferred quickly from one office to another thereby increasing the facilities via the latter office. A number of cases have occurred also in which type D equipment has been used to provide facilities for sudden growth in oil fields.

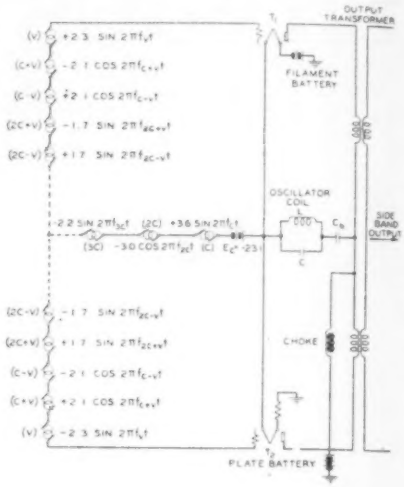

Fig. 32—A Diagram of Voltages which if Applied to the Grids as Shown Produce the Same Results in the Plate Circuit as the Carrier and Voice Voltages in the Modulator of Fig. 3.

While this use of the system forms a comparatively small part of its field of application, it is an advantage which, at times, may be of considerable importance. The principal use of the system is to provide additional facilities which are required as a result of permanent traffic growth where these can be provided more economically by means of this system than by stringing additional wire.

Conclusions

With the development of the type D carrier telephone system, the art of carrier telephony has been brought to the point where it can be used to advantage in providing telephone facilities for much shorter circuits than have been economical heretofore. Type D systems now in service are operating principally over distances of about 75 to 200 miles; although in certain cases where the conditions are favorable, systems as short as about 50 miles are in use. The exact distance beyond which it is more economical to employ this carrier system than to string additional wire, is, of course, dependent upon the conditions applying to each particular case. For greater distances, up to the limit of the operation of the system, the economies effected by its use increase quite rapidly.

"REBUILT" TELEPHONE APPARATUS and exchange equipment saves you 30 to 50 per cent without sacrificing quality or efficiency.
SWITCHBOARDS—Telephones—Apparatus—Protection Equipment—Cable—Everything you need for the installation and operation of a complete exchange—Magneto or Central Energy—of the best and most reputable manufacturers.
Fourteen years' successful operation of our rebuilt equipment department puts it past the experimental stage. Quality and price will make you a permanent customer. Better investigate.
BARGAIN BULLETIN NO. 78 FREE
Address "REBUILT" EQUIPMENT DEPARTMENT
Premier Electric Company 1800-4 Grace St. Chicago, Ill.

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TELEPHONE BATTERIES
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Factory: Madison, Wis. *Sales Office:* 30 N. Michigan Ave., Chicago

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"Know where you stand"
Investigate Our Centralized Accounting Plan
This monthly Audit will save you lots of money and give you important information that you should have about your business—the best of all business, if properly managed.
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Heavy Work? Acid-Core!
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KESTER SOLDER COMPANY
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Established 1899
4218 Wrightwood Ave. Chicago, Ill.
KESTER SOLDER
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CERTIFIED PUBLIC ACCOUNTANTS
Coffey System
TELEPHONE ACCOUNTING EXCLUSIVELY

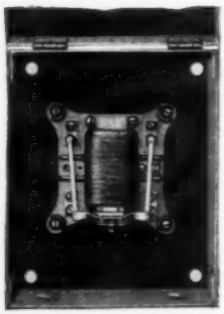
Introducing our CENTRAL AUDITING DEPARTMENT to enable Telephone Companies to reduce their auditing expense and encourage more frequent audits, thereby preventing the accumulation of errors and possible financial losses.

To save the expense of a travelling auditor, we will audit the books and records of Telephone Companies in our general offices. Our office facilities also permit us to make an audit in less time and a saving in cost to our client.

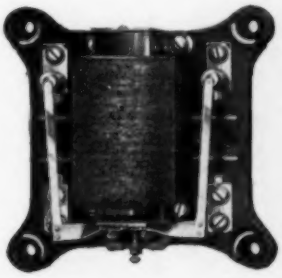
All audits are made by our regular staff of telephone accountants; when completed, a certified report, in book form, is issued, consistent with our usual practice.

Complete details regarding our new service will gladly be furnished.

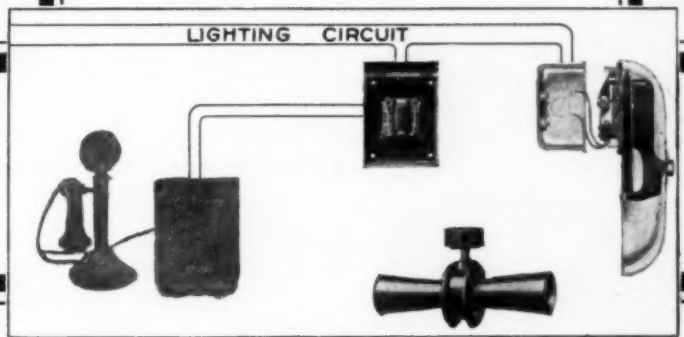
Coffey System and Audit Company
15th Floor Consolidated Bldg.
INDIANAPOLIS - - INDIANA



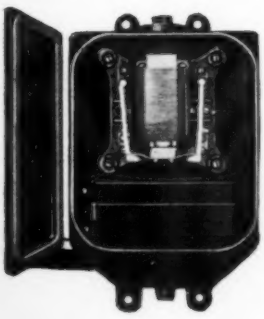
Signal Engineering
Loud Ringing Telephone Sets
Relay operates on standard ringing current, picking up local current to ring loud *Signal Engineering* Bell or Horn.



ABOVE: Relay with non-weatherproof housing.
BELOW: Relay with condenser in weatherproof housing.

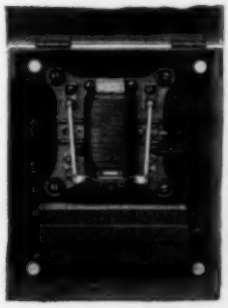


ABOVE: Relay without housing.
BELOW: Relay with condenser in non-weatherproof housing.



Relay supplied for AC or DC with either 1000 or 1700 OHM Coil with or without condenser. Approved by Underwriters' Laboratories, Inc.
Samples for test to Telephone Companies.

SIGNAL
ENGINEERING & MFG. CO.
162 WEST 14TH STREET, NEW YORK



The performance of the type D system is comparable with that of a corresponding wire circuit. The form of the equipment is such that it is well adapted to the various office conditions, it can be used to provide facilities quickly, and can be transferred readily from one location to another in case of emergency.

On June 1, 1928, approximately 125 type D carrier telephone systems were in service and operating satisfactorily. It is expected that by the end of 1928 the number of systems in use will have increased to about 225. The growth in short open-wire toll circuits is such that there is a considerable field of application for this system.

Activities of the Manufacturers

Copperweld Has Southeastern District Offices

The Copperweld Steel Company has formed a Southeastern district, comprised of Georgia, Alabama, Tennessee, Florida, Mississippi and part of Louisiana, with Mr. P. A. Terrell in charge as district manager. The office of this district is located in the American Traders Bank Building, Birmingham, Ala.

Kellogg Switchboard to Be Installed in Boyertown, Penna.

The Conestoga Telephone and Telegraph Company of Birdsboro, Pa., recently purchased the telephone exchange at Boyertown, Pa. Seeing the need of a new and more up-to-date telephone system in this progressive community, they have placed an order with the Kellogg Switchboard & Supply Company for a Universal switchboard, to be shipped in July.

The new switchboard, to replace the magneto board now in use there, is to be a three-position board having 300 universal local lines, 30 magneto toll lines and 20 magneto rural lines. Position No. 1 will be arranged for toll, and positions Nos. 2 and 3, for local service.

The Conestoga Telephone and Telegraph Company have also purchased a building, which is being remodeled into a beautiful and modern exchange.

The Conestoga Company can boast of being about 100 per cent Kellogg equipped, having Kellogg switchboards in all their exchanges.

New Assistant to Vice-President for Westinghouse

William G. Marshall, since 1926 director of personnel for the Philadelphia company and affiliated corporations, on July 1 will become assistant to Vice-President T. P. Gaylord of the Westinghouse Electric and Manufacturing Company. Mr. Gaylord, in announcing Mr. Marshall's new position, states that he will be in charge of employes' relations, but that no change is contemplated in the existing positions of director of personnel or manager of employes' service.

To Cover Southern Territory for Otto Bernz Co., Inc.

A. U. Peterson, 537 E. College st., Shreveport, La., will represent the Otto Bernz Co., in the southern states in future, offering their lines of furnaces, torches and plumbing tools to the jobbing trade in Alabama, Florida, Georgia, Mississippi, North Carolina, South Carolina, Tennessee, Virginia and West Virginia. Peterson will be on the road continuously and will call upon the trade some five times each year. He is connected with the office of C. F. Adams of Forth Worth, Texas. The latter has been covering the states of Texas, Oklahoma, Arkansas, Louisiana and Kansas for the Otto Bernz Company for several years.

The Otto Bernz Comjany is now well represented in the south and southwest, covering practically every state in that section of the country where so much development is being promoted.

Veteran Employees Present Flag Pole and Flag

On the afternoon of Flag Day employes of the Stromberg-Carlson Telephone Manufacturing Company gathered in front of the recently completed Plant B on Blossom Road, Rochester, to witness the presentation of a flag pole and flag to the company. This was made by 54 employes who have a service record of more than 25 years with the organization.

Robert Larson, who entered the employ of the Stromberg-Carlson Company March 15, 1899, and who is the second oldest employe in point of service, made the presentation speech. Several employes of more than 25 years' service, still associated with the company, but unable to be present, participated in the gift. One is in South America, one in Indiana, and several are in Chicago, where the company maintains an office. The gift was accepted on behalf of the company by W. R. McCanne, president, who himself has been with the company for more than 20 years.

Coffey Opens New Department in Indianapolis Office

In a letter sent to the telephone companies of the country The Coffey System and Audit Company of Indianapolis, Indiana, announced the opening of their new department, The Central Auditing Department.

The Coffey System and Audit Company, who first devised a means by which the smaller telephone companies could maintain complete and systematic accounting records at a small cost, has now gone one step further in devising a means where auditing service may be obtained at a great saving.

In their letter, the Indianapolis accounting organization emphasizes the large expense often entailed in employing a telephone specializing accountant from a distant city. To eliminate this expense, the Coffey organization will make audits in their Indianapolis office. The books of the telephone company and other supporting data are sent to them by express and returned by express to insure safety. A certified report will be rendered in the manner heretofore employed by the Coffey System.

In a statement, J. W. Coffey, president of the Coffey System and Audit Company, said, "We have learned a great deal about telephone companies in the twenty years we have been doing their accounting work. Our various services are thoroughly tried before offering them to the public, and in this connection, we hope to make our Central Auditing Department another successful adjunct to our organization."

Automatic Volume Control and Screen Grid Circuits in 846 Stromberg-Carlson

The advantage of reception at practically uniform volume of any desired intensity, through the use of an automatic volume control, is added to those inherent in improved screen grid circuits in the new No. 846 Stromberg-Carlson Art Console.

"Linear" power detection—made possible by three screen-grid tubes in the radio frequency stages—is used in this model for improved reception from high modulation broadcast stations; two of the new UX-245 tubes are used in push-pull for undistorted output at loud volume; and an improved dynamic speaker with a highly responsive diaphragm is built into the cabinet.

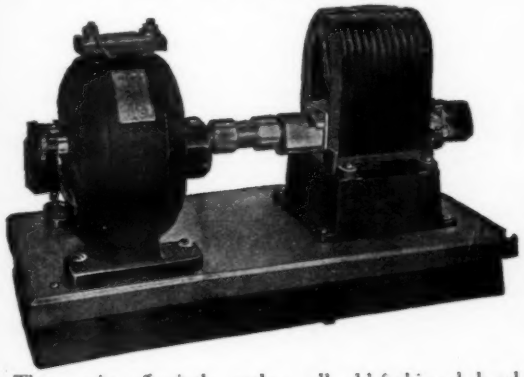
The tuning meter for visual tuning, esssential with the automatic volume control feature, is conveniently located immediately above the single station selector knob and both are illuminated. The more customary manual volume control knob is also provided.

Provision is made for using the high

HOLTZER-CABOT

Magneto - Ringing - Motor - Generators

ALWAYS DEPENDABLE



These units effectively replace all old-fashioned hand and battery ringing methods. Extreme simplicity of operation and low cost offer advantages over all other devices.

Cuts operating expenses by eliminating expensive and troublesome battery equipment.

Make possible a swift, sure, carefree service that pleases both subscriber and operating company as well.

Can be supplied for any voltage or special current. A thorough test will convince you.

Complete data and specifications on request.

HOLTZER-CABOT ELECTRIC CO.

125 Amory Street, Boston, Mass.

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Get EVER-PROTECT aid in your construction.

EVER-PROTECT has proved practical and profitable in making many hundreds of cable installations underground without a conduit. It protects cable against storm damage, corrosion, chemical action, electrolysis and abrasion.

In liquid form EVER-PROTECT is great for overhead work, protecting your cable and messengers against chemical action and other destructive influences.

Ask your nearest jobber for complete details.

EVER-PROTECT CABLE COMPOUND

National Cable Compound Co.

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BATTERIES

have faithfully served the Telephone Industry for the past 35 years.

This significant fact assures the same dependability for the future.

THE ELECTRIC STORAGE BATTERY CO.

PHILADELPHIA

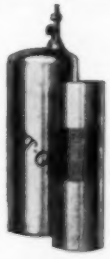
Exide Batteries of Canada, Ltd., Toronto

Prest-O-Lite Is Unusually Convenient

. . . easy to handle on a pole, underground, in the transformer room, or in the shop . . . easy to work in corners and close quarters . . . easy to regulate to the exact heat required . . . no pumping, no preheating, no waste of fuel between jobs.

Electrical Contractors and Utility Companies prefer Prest-O-Lite blow-torches because they speed up the work and do a better job at lower cost.

Ask your local Prest-O-Lite Gas Distributor to demonstrate this equipment for you or write us for complete information.



Prest-O-Lite is available everywhere. Anyone of 15,000 Prest-O-Lite Exchange stations can supply you quickly with a full tank.

THE PREST-O-LITE CO., Inc.

Unit of Union Carbide and Carbon Corporation

NEW YORK: Carbide and Carbon Bldg.
SAN FRANCISCO: Adam Grant Building
IN CANADA: The Prest-O-Lite Company of Canada, Ltd., Ontario

Prest-O-Lite GAS

quality audio amplifier of this receiver for reproduction of phonograph records in conjunction with the new Stromberg-Carlson 3-A flexible armature magnetic pickup outfit. A jack in the rear of the chassis is so arranged that by turning the manual volume control completely "off," the pick-up is connected into circuit.

The cabinet which incloses the No. 846 receiver is of contrasting walnut and is extremely rich and distinctive. Its shape is half-octagonal using six supporting legs with a neatly designed stretcher tying the bottom of these legs securely together. When swinging doors are opened their inside decoration blends neatly into the side pedestal effect of the cabinet. The control knobs for the radio receiver project through appropriate places in a delicate reproduction of hand carved design of dogwood trees in bloom. As in all Stromberg-Carlsons, speaker, cabinet, and chassis are all carefully matched before their final assembly to give best overall results in fine tone quality.

Bulletin on Rectifiers

A new bulletin describing the principles and applications of Kuprox dry plate rectifiers has just been issued by the Kodel Electric & Manufacturing Co. of Cincinnati, O. This new type of rectifier has many interesting features and is said to be finding favor in numerous fields where a simple, convenient rectifying device is needed. It has found applications in telephone, railway signalling and other fields where trickle charging of storage batteries is advisable. A copy of the bulletin may be secured from the company.

Folder Tells of Prettyman Preserved Poles

J. F. Prettyman & Sons, Charleston, S. C., have issued the following folder:

The most important reason why Prettyman preserved poles of Southern yellow pine should support your telephone, telegraph, power or light lines is that they render longest and most dependable service at least cost.

Of all woods used for poles, Southern yellow pine has the greatest static bending strength under a steadily applied load, with a modulus of rupture of 8,000 to 8,700 pounds per square inch as against the next strongest pole wood with 5,600.

Its use, therefore, reduces the number of poles required for a given load, through longer spans, with a corresponding elimination of cross-arms, insulators and other line hardware.

Longevity, however, rather than strength, is the greatest economic factor of Prettyman preserved pine poles. Prettyman preservation (impregnation with hot creosote oil under high pressure) multiplies the natural life span of the wood three to five times, maintaining intact its natural strength from 25 to 40 years. The experience of many leading public utility companies has been that poles of creosoted pine last even longer, under heavy loads and most trying conditions.

Prettyman preservation defeats decay. It renders your poles immune to the attacks of destructive fungi, white ants and woodpeckers. It preserves the great strength of Southern yellow pine to resist storms and ice-loads which would send other poles crashing to earth.

Every phase in the production of Prettyman preserved poles is a Prettyman operation—careful selection and felling of the tree in a Prettyman forest; transportation to the seasoning yards; peeling off the bark; seasoning; roofing, gaining and boring; and finally, expert pressure-treatment with creosote in the most complete and modern wood preserving plant on earth.

From the felling of the tree to its subjection to treatment, it is jealously guarded from fibre-strain or infection, assuring the consumer a pole in which the *full natural strength of the wood* will be retained throughout the multiplied years of its life.

Yet, the low *initial* cost of Prettyman preserved poles as compared with other poles is surprising. Further information without obligation to you. Write J. F. Prettyman & Sons' Wood Preserving Plant, Charleston, S. C.

Studying Telephone Methods

(*Continued from page 22.*)

dotted circle. Then allow the circuit shown in Fig. 243 to come into action. This will drive the wheel the remainder of the circle much quicker than applying separate impulses, so that the return to normal is very quick. When the normal position is reached the buzzer circuit is opened, and the wheel allowed to remain at normal until driven on again by impulses from some outside source.

In our next chapter we will discuss the circuit arrangements to accomplish this work.

Illinois District Meeting

The next district meeting will be held Thursday, July 18th, at Freeport, Illinois. Mr. George X. Cannon, past president of your association, and general manager of the Stephenson County Telephone Company, is preparing for a large crowd. A good program has been arranged, and we need your presence to make the occasion a success.

Sign along highway in Virginia: "Men working." One wonders whether it is a boast, an apology, an explanation, or just a bit of information.

South American Radio-Phone Service Opened

(*Continued from page 32.*)

of the transmitters may be operated simultaneously within four-tenths of a meter without causing interference or cross-talk, engineers explained.

The voice current from a person talking in North America is received over a telephone line coming from the long distance telephone office in New York City to a "line terminal room." Here the voice is transferred to the radio circuit, amplified and passed to a modulator.

Into this modulator there is also sent a current of high frequency at a range of 5,000,000 to 25,000,000 cycles a second. The frequency of this "carrier current" is accurately maintained by means of a quartz crystal. The carrier wave, modulated by the voice wave, passes to the final amplifiers, of which water-cooled vacuum tubes form an integral part.

When Lawrenceville station is in full operation four transmitters will be in service, three forming parts of circuit facilities to London via which telephone communication is established with Europe, and one for the circuit to South America.

Telephone Pioneers of America to Meet in Minneapolis

The sixteenth meeting of the association and the eighth meeting of the general assembly of the Telephone Pioneers of America will be held at Minneapolis, Minn., October 18th and 19th, 1929. Programs have been mailed, which include many interesting features.

Phone Company Improvements

Bluffton, Ohio.—Work on a $50,000 improvement project that is to result in a complete replacement of all local property of the Bluffton Telephone Co. will be started immediately, officials of the organization announced.

Following the setting of new poles here workmen will complete the installation of a new switchboard and the placing of new equipment in the homes of Bluffton subscribers, according to present plans of the Utilities Service Corporation, which controls the local company. Work on the new system is not expected to be completed before five months.

Survey for new pole routes through the town was completed early this week and work on the project is to be started at once. All wires will be carried in cables on the new routes.

The main line of the new routing system will run through an alley between Main and Jackson streets.

The woman who in the days of the silent movies read the titles aloud now talks continuously during the songs.

New Bronze Drop Wire Used by Kellogg Company

A goal, toward which telephone equipment companies have been working for many years, was reached by the Kellogg Switchboard & Supply Company in perfecting bronze drop wire. Considerable research and experiment was necessary before the Kellogg Company, working with the Anaconda Copper Company, was able to produce this new wire, which incorporates a solid bronze wire conductor instead of the type formerly in use.

It is generally agreed that a successful drop wire must contain features that will assure perfect transmission and long life. Low resistance is necessary for good transmission, and the life of the wire is dependent upon light weight, great tensile strength and high quality of insulation. In perfecting this new wire, the engineers took these facts into consideration, and produced a drop wire that all up-to-date telephone men agree is far superior to other types.

Bronze has always been recognized as an excellent conductor. Kellogg's bronze drop wire has a conductivity of 85 per cent, I. A. C. S., at 20 degrees centigrade, as compared with 30 to 40 per cent for the old type. This factor reduces its resistance to 32 ohms per mile—nearly equal to that of pure copper. Thus it provides for longer lengths to be run without sacrificing transmission.

Kellogg drop wire is small in diameter, yet has the very high tensile strength of 150 pounds. Therefore, it is less subject to damage by wind or sleet storms, and can be safely strung over long spans.

Any telephone man can appreciate the advantage of a wire that will not rust at the points after scraping, that will not rust at the ends, and that will not deteriorate under adverse climate conditions. Kellogg bronze is noncorrosive, which, of course, makes it more desirable for drop wires than either steel or copper.

Another item worth considering is the high scrap or salvage value of the bronze conductor. After years of service, its value will average $1.50 for each 1,000 feet.

The life of a drop wire almost wholly depends upon the quality of its insulation. It must be able to withstand the heat and dryness of summer as well as the cold, sleet and ice of winter. Kellogg, unlike others, makes only one grade of insulation, which has set the standard in the independent field. The rubber used is equal to new code rubber, the same as specified for safety on light and power wires by the Underwriters' Laboratories. This high pure rubber content gives great strength and toughness. The rubber is vulcanized very slowly at a temperature which thoroughly "cures" it, preventing hardening and cracking. Its application by the "tubing procress" leaves it seamless.

A tightly woven, two-ply, long wearing outer braid is placed over the rubber. This wiring, after being thoroughly saturated in wax, is given a second coating of high luster finishing wax, making it impervious to all weather conditions.

Statistics from the Kellogg Switchboard & Supply Company indicate that this new drop wire has been very well received by the telephone industry, and telephone men agree that it will become the universal standard.

Merrick Elected Westinghouse President

F. A. Merrick, an executive well known within the electrical industry, was elected president of the Westinghouse Electric and Manufacturing Company by the board of directors of the company, meeting in New York City, Wednesday, June 26.

In announcing the election of Mr. Merrick to the presidency of the company, A. W. Robertson, chairman, also stated that the board of directors, while accepting the resignation of E. M. Herr, president since 1911, in order that he might go on an extended vacation, had elected Mr. Herr vice-chairman.

Mr. Merrick advances into the position of president from the position of vice-president and general manager of the Westinghouse Electric and Manufacturing Company. He is a native of New Jersey, and received his technical education at Lehigh University. Shortly after his graduation he was employed by the Steel Motors Company, a subsidiary of the Lorain Steel Company, where he was responsible for many important electrical inventions, and where he held the position of manager and chief engineer.

Mr. Merrick's headquarters will be located in Pittsburgh.

RECONSTRUCTED EQUIPMENT

Kellogg No. 6B Cordless P. B. X. board with 7 local lamp lines and 2 trunk Ckts. @ $50.00—10-local and 3 trunk type @ 65.00

Kellogg No. 97 or No. 118 Common battery desk set complete with No. 404 or No. 259 Steel signal sets, straight line or 16-33-50 and 66 cycle ringer 7.00

Kellogg or Dean drop coils, 100 ohm 35c ea. 500 ohm @ ..... .50

Western Elec. No. 329 Transmitters with back & mouthpiece @ 1.25

Western Elec. No. 250 or 229 Transmitters with back and mouthpieces @ 1.15

Western Elec. No. 143 Receivers with cords @ 1.25

Gray 3-slot wall or desk type paystations @ 5.75

Gray 5c single slot desk or wall type paystations @ 1.25

Kellogg No. 30A combine line drops and jacks, per strip of 10 @ 12.50

Stromberg No. 986 C. B. desk set complete with No. 1132 Steel bell box with straight line or 16-33-50 or 16 cycle ringers @ 6.75

Kellogg No. 34 2-M. F. Condensers @ .40

Western Elec. No. 20 desk set with W. E. Trans. & Rec. and new cabinet inside connection signal set 3-bar 1000 or 1600 ohm $10.00—4-bar $10.75—5-bar @ 11.75

Kellogg No. 22 L. C. Transmitters with back and mouthpieces @ 1.10

Write for Our Bulletin

REBUILT ELECTRIC EQUIPMENT CO.
Not Inc.
1940 W. 21st St., Chicago

PEARL LIFE-TIME DROP WIRE BRACKETS

Save time, labor and waste. Hot-galvanized screw-hooks and malleable castings are separable and indestructible. Standard 2 groove porcelain. Stocked by telephone manufacturers.

WM. H. PEARL CO., Indianapolis

Send for free sample and prices on

UNIVERSAL DROP WIRE INSULATORS

Universal Specialty Company
711 Poplar St., Terre Haute, Ind.

SCRAP PLATINUM

Highest prices paid for discarded or obsolete telephone and switchboard apparatus; platinum contact relays, ring keys, etc. Have specialized in this field for many years.

CONTACT METALS CO.
2500 S. Wabash Ave., Chicago

UNIQUE

HEAT PROOF

BALANCED LADLE

Reduces Overhang to a Minimum

You pour the metal exactly where you want it. Drop by drop or in a stream!

The ladle cannot slip, twist or pull out of the *ventilated* handle.

Interchangeable—no holes to drill—a screw driver is the only tool required to attach or remove.

Bowl Diameters 2½, 3, 3½, 4"

GET ONE ON TRIAL

UNIQUE MFG. CO., INC.
221 Whiting St., Chicago, Ill.

Kellogg Assigns Southern Territory to H. M. Stewart

In spite of the numerous friends he made during his stay at the Chicago office of the Kellogg Switchboard & Supply Company, Mr. H. M. Stewart became homesick for the Southland, where he was born and where he lived practically all his life. He is contented now, for the Kellogg Company has assigned the Georgia, Alabama, Florida and South Carolina territory to him, where he will handle the sales of Kellogg telephone equipment.

Mr. Stewart has devoted all of his business career to the telephone industry. While still a high school student, he obtained a position with the Southern Bell Telephone Company as a night operator in his home town, Centerville, Ala. After two years he was promoted to the position of "grunt," or helper to a construction crew, and later was assigned to the Anniston, Ala., exchange as station installer.

This was just about the time of the World War, when he readily exchanged his cable tester for a khaki uniform. He was assigned to a special detachment of the Signal Corps, and was stationed at Camp Pike, Ark., on special duty.

Returning from the army, Stewart naturally turned back to the telephone field, where he had already acquired a reputation as a "good man to have on the job." After working just a short time as station repairman at the Tuscaloosa, Ala., exchange, Mr. Stewart was transferred to the commercial department as cashier. This was the turning point of his career, for his days of looking for "telephone troubles" were over.

During the next three years he served in the respective capacities of contract clerk, adjustment clerk and collection supervisor at Montgomery, Ala., and commercial supervisor at Gadsden, Ala., where he left the Bell Telephone Company to work for the Kellogg Switchboard & Supply Company.

This rounds out 13 or more years of service in the telephone world, during which time Mr. Stewart has earned the reputation of being a telephone man of the highest caliber.

FOR SALE

2 conductor black silk desk stand and receiver cords, per set, 40c. W. E. No. 47 fuses, $6.00 per 100. W. E. No. 14 terminals, 16 pair less stubs @ $4.00. W. E. NEW 3 conductor swbd. cords with No. 109 plugs attached, 50c. Heminway No. 42 glass insulators @ $5.00 per 100.

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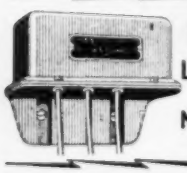
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Table of Contents

Editorial 17-18
An Ideal and Its Realization—Do Nothing Till the Plant Falls Down—Why Worry About Saturation—The Federal Communication Bill—An Important Telephone Consolidation
Television in Color, by H. E. Ives 19-20-44
Telephone Transmission, B. C. Burden 21-22-23
Studying Telephone Methods, by E. R. Collins 24-25-28-29
Tri-State Tel. & Tel. Company Sold to Theodore Gary & Co. .. 29
Line and Desk 30
Means and Methods of Circuit Coupling, by F. J. Dommerque 32-34-36
Associated Telephone Utilities Co., Acquires Large Holdings in Several States 46
Manufacturers and Jobbers 46-47

Index to Advertisers

A

American Cross Arm & Conduit Co 13
American Electric Co., Inc 6
American Steel & Wire Co ..... —
American Telephone & Telegraph Co. 16-33
Automatic Electric Co 26-27
Atlantic Hotel 45

B

Bell Lumber & Pole Co 13
Bernz Co. 15
Berry, L. M. 48
Blake Signal & Mfg. Co 39
Block, Lynton T., & Co 11
Bowdle Accounting System ..... —
Buckeye Telephone & Supply Co 48

C

Carbon Products 39
Chance Company 2
Coffey System & Audit Co 15
Colson Co., The 43
Contact Metals Co 47
Cook Electric Co 9-10
Copperweld Steel Co ..... —
Curtin-Howe Corp. 1

E

Earl L. Carter 48
Electric Storage Battery Co 41
Everstick Anchor Co 48

F

French Battery Co 12

G

Great Northern Hotel 48
Graybar Electric Co 39

CONVENTION SCHEDULE.

United States Independent Telephone Association, Stevens Hotel, Chicago, October 22, 23, 24, 25, 1929.

Independent Pioneer Telephone Association, Stevens Hotel, Chicago, October 24, 1929.

H

Herdrich & Boggs 48
Holtzer-Cabot Electric Co 41

I

Indiana Steel & Wire Co 43
International Creo. & Con. Co 50

J

Johnson, A. J., Elec. Co., Inc ..... —
Johnson, J. K ..... —

K

Kearney Corp., Jas. R 1
Kellogg Switchboard & Supply Co 4
Kestor Solder Co 12

L

Long-Bell Lumber Co 43

M

Matthews Corp., W. N 3
MacGillis & Gibbs 13
Minnesota Electric Co 48
Miller, Wm. M 48

N

National Cable Compound Co 41
National Carbon Co 37
Naugle Pole & Tie 13
Northern White Cedar Ass'n 14

P

Premier Electric Co 12
Prest-O-Lite Co., Inc 43
Prettyman & Sons, J. F 35

R

Rebuilt Electric Equipment Co 41
Reliable Electric Co 7
Republic Cedar Co ..... —

S

Sands Electric Co 1
Signal Eng. & Mfg. Co 15
Standard Underground Cable Co ..... —
Stewart Bros. 39
Stromberg-Carlson Tel. Mfg. Co 8

T

Telephone Repair Shop 48
T. M. Partridge Co 13
Templeton-Kenly Co. 13
Texas Creosoting Co 12

U

Universal Specialty Co 47
Unique Mfg. Co 47

W

Welker, J. H 48
Western Electric 5
Wright Metal Co ..... —
Wm. H. Pearl 47
J. G. Wray & Co 48

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